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TABLES TO FACILITATE THE PRACTICE OF GREAT CIRCLE SAILING.

TABLES

TO

FACILITATE THE PRACTICE

OF

GREAT CIRCLE SAILING,

AND

THE DETERMINATION OF AZIMUTHS.

BY

JOHN THOMAS TOWSON.

PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF THE ADMIRALTY.

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CONTENTS.

	Page
Table of Courses, &c.	2
Explanation	38
Description of the Linear Index	39
Description of the Tables	39
To find the Latitude of Vertex and Longitude from Vertex by Linear Index	39
To find Great Circle Course, &c.	40
Examples	41
Windward Great Circle Sailing	45
Composite Great Circle Sailing	48
Application of the Linear Index and Great Circle Tables to the Determination of Azimuths	51
Construction of the Linear Index and of the Tables	54
Note	57

ADVERTISEMENT.

It is now universally known by seamen that the shortest line which can be drawn between any two places on the surface of the globe is an arc of a great circle passing through them both; and, moreover, that the rhumb line, or the apparent course upon the chart drawn from one of those places to the other, can never coincide with *that* great circle unless both places lie on the Equator or on a common meridian. It is not, therefore, from want of general conviction of the propriety of having recourse to Great Circle Sailing that it is so rarely used by practical men, but from the tedious length of the calculations requisite to determine the series of ever-changing courses which a vessel must pursue in order to adhere to the track of a great circle.

It is, however, a very satisfactory indication of the growing attention to the science of navigation, that in several recent voyages the sound principle of conducting a ship along the arc of a great circle appears to have been adopted; and not only in those glaring cases where a large amount of distance may be obviously saved, but in the more every-day work of selecting the most advantageous tack on which to lay the vessel with a foul wind; every intelligent navigator has become aware, that, in high latitudes, if on the wrong tack, because it seems to be within a few points of the art course, she may in fact be so led away from her proper course as to be ually receding from her port instead of nearing it.

When, therefore, a concise method of solving this wearisome problem was published by Lieutenant Raper, in his excellent work "The Practice of Navigation," it was hailed by every seaman as a boon of great value; but since that, a method has been devised by Mr. John T. Towson, Examiner to the Mercantile Marine Board at Liverpool, which is so brief, that, by means of a diagram and a table, the whole operation of finding the several successive courses is reduced to almost an affair of inspection.

With a degree of public spirit that cannot be too much admired, Mr. Towson at once presented these fruits of his ingenuity to the Lords Commissioners of the Admiralty, and their Lordships have ordered them to be printed in the following pages for the use of all mariners.

Subsequently, Mr. Towson communicated a method by which these tables may be applied to the computation of Azimuths, and it has been added to this edition.

F. B.

Hydrographic Office,
1st April 1852.

TABLES

FOR

GREAT CIRCLE SAILING.

Longitude from Vertex.	LATITUDE OF VERTEX.																		Longitude from Vertex.
	1°			2°			3°			4°			5°						
	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.				
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′				°
0	1 0	90 0	60	2 0	90 0	60	3 0	90 0	60	4 0	90 0	60	5 0	90 0	60				0
1	1 0	89 59	60	2 0	89 58	60	3 0	89 57	60	4 0	89 56	60	5 0	89 55	60				1
2	1 0	89 58	60	2 0	89 56	60	3 0	89 54	60	4 0	89 52	60	5 0	89 50	60				2
3	1 0	89 57	60	2 0	89 54	60	3 0	89 51	60	3 59	89 48	60	4 59	89 45	60				3
4	1 0	89 56	60	2 0	89 52	60	2 59	89 48	60	3 59	89 44	60	4 59	89 40	60				4
5	1 0	89 55	60	2 0	89 50	60	2 59	89 45	60	3 59	89 40	60	4 59	89 35	60				5
6	1 0	89 54	60	1 59	89 48	60	2 59	89 42	60	3 58	89 36	60	4 58	89 29	60				6
7	1 0	89 53	60	1 59	89 46	60	2 58	89 39	60	3 58	89 32	60	4 58	89 24	60				7
8	0 59	89 52	60	1 59	89 44	60	2 58	89 36	60	3 57	89 27	60	4 57	89 18	60				8
9	0 59	89 51	60	1 59	89 42	60	2 57	89 33	60	3 57	89 23	60	4 56	89 13	60				9
10	0 59	89 50	60	1 58	89 40	60	2 57	89 30	60	3 56	89 19	60	4 55	89 8	60				10
11	0 59	89 49	60	1 58	89 38	60	2 56	89 26	60	3 56	89 14	60	4 54	89 2	60				11
12	0 59	89 48	60	1 58	89 36	60	2 56	89 23	60	3 55	89 10	60	4 53	88 57	60				12
13	0 59	89 47	60	1 57	89 34	60	2 55	89 20	60	3 54	89 6	60	4 52	88 52	60				13
14	0 58	89 46	60	1 57	89 32	60	2 54	89 17	60	3 53	89 1	60	4 51	88 47	60				14
15	0 58	89 45	60	1 56	89 30	60	2 54	89 14	60	3 52	88 56	60	4 50	88 42	60				15
16	0 58	89 44	60	1 56	89 28	60	2 53	89 11	60	3 50	88 51	60	4 49	88 37	60				16
17	0 57	89 43	60	1 55	89 26	60	2 52	89 8	60	3 49	88 47	60	4 48	88 32	60				17
18	0 57	89 42	60	1 54	89 24	60	2 51	89 5	60	3 48	88 44	60	4 46	88 27	60				18
19	0 57	89 41	60	1 53	89 22	60	2 50	89 2	60	3 47	88 41	60	4 44	88 22	60				19
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23	0 55	89 37	60	1 50	89 14	60	2 46	88 50	60	3 41	88 27	60	4 36	88 2	60				23
24	0 55	89 36	60	1 49	89 12	60	2 45	88 47	60	3 40	88 23	60	4 34	87 57	60				24
25	0 55	89 35	60	1 49	89 10	60	2 44	88 45	60	3 38	88 19	60	4 32	87 53	60				25
26	0 54	89 34	60	1 48	89 8	60	2 43	88 42	60	3 36	88 16	60	4 30	87 48	60				26
27	0 54	89 33	60	1 47	89 6	60	2 41	88 39	60	3 34	88 12	60	4 28	87 43	60				27
28	0 53	89 32	60	1 46	89 4	60	2 40	88 36	60	3 32	88 8	60	4 25	87 39	60				28
29	0 53	89 31	60	1 45	89 2	60	2 38	88 33	60	3 30	88 4	60	4 22	87 34	60				29
30	0 52	89 30	60	1 44	89 0	60	2 36	88 30	60	3 28	88 0	60	4 19	87 30	60				30
31	0 52	89 29	60	1 43	88 58	60	2 35	88 28	60	3 26	87 56	60	4 17	87 25	60				31
32	0 51	89 28	60	1 42	88 56	60	2 33	88 25	60	3 23	87 52	60	4 14	87 21	60				32
33	0 51	89 27	60	1 41	88 54	60	2 31	88 22	60	3 20	87 49	60	4 11	87 16	60				33
34	0 49	89 26	60	1 40	88 52	60	2 29	88 19	60	3 18	87 45	60	4 8	87 12	60				34
35	0 49	89 25	60	1 38	88 50	60	2 27	88 16	60	3 16	87 42	60	4 5	87 8	60				35
36	0 48	89 24	60	1 37	88 48	60	2 26	88 13	60	3 14	87 38	60	4 2	87 3	60				36
37	0 48	89 23	60	1 36	88 46	60	2 24	88 10	60	3 11	87 35	60	3 59	86 59	60				37
38	0 47	89 22	60	1 35	88 44	60	2 22	88 8	60	3 9	87 32	60	3 56	86 55	60				38
39	0 47	89 21	60	1 34	88 42	60	2 20	88 5	60	3 7	87 28	60	3 53	86 51	60				39
40	0 46	89 20	60	1 32	88 41	60	2 18	88 3	60	3 4	87 25	60	3 50	86 47	60				40
41	0 46	89 20	60	1 30	88 39	60	2 16	88 0	60	3 1	87 22	60	3 47	86 43	60				41
42	0 45	89 19	60	1 29	88 38	60	2 14	87 58	60	2 59	87 19	60	3 44	86 39	60				42
43	0 44	89 18	60	1 28	88 37	60	2 12	87 56	60	2 57	87 16	60	3 41	86 35	60				43
44	0 43	89 18	60	1 27	88 35	60	2 10	87 54	60	2 54	87 13	60	3 38	86 31	60				44
45	0 43	89 17	60	1 26	88 34	60	2 9	87 52	60	2 52	87 10	60	3 35	86 28	60				45

Longitude from Vertex.	LATITUDE OF VERTEX. 1° Lat.	Course.	Dist.	2° Lat.	Course.	Dist.	3° Lat.	Course.	Dist.	4° Lat.	Course.	Dist.	5° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	°	′ ″	° ′	°	′ ″	° ′	°	′ ″	° ′	°	′ ″	° ′	°	′ ″	°
46	0 42	89	17 60	1 24	88	32 60	2 7	87	50 60	2 49	87	7 60	3 31	86	24 60	46
47	0 41	89	16 60	1 23	88	31 60	2 5	87	48 60	2 46	87	4 60	3 27	86	21 60	47
48	0 40	89	15 60	1 21	88	30 60	2 2	87	46 60	2 43	87	1 60	3 23	86	17 60	48
49	0 39	89	14 60	1 20	88	29 60	2 0	87	44 60	2 40	86	58 60	3 19	86	14 60	49
50	0 38	89	14 60	1 18	88	28 60	1 57	87	42 60	2 37	86	56 60	3 14	86	10 60	50
51	0 37	89	13 60	1 17	88	26 60	1 55	87	40 60	2 34	86	53 60	3 10	86	6 60	51
52	0 36	89	12 60	1 15	88	25 60	1 52	87	38 60	2 30	86	50 60	3 6	86	3 60	52
53	0 36	89	11 60	1 13	88	23 60	1 49	87	36 60	2 26	86	47 60	3 2	86	0 60	53
54	0 35	89	11 60	1 11	88	22 60	1 46	87	34 60	2 22	86	45 60	2 58	85	57 60	54
55	0 35	89	10 60	1 9	88	21 60	1 43	87	32 60	2 18	86	43 60	2 53	85	54 60	55
56	0 34	89	10 60	1 8	88	20 60	1 40	87	30 60	2 15	86	40 60	2 48	85	51 60	56
57	0 33	89	9 60	1 6	88	19 60	1 37	87	28 60	2 11	86	38 60	2 43	85	48 60	57
58	0 32	89	9 60	1 4	88	18 60	1 35	87	27 60	2 8	86	36 60	2 39	85	45 60	58
59	0 31	89	8 60	1 2	88	17 60	1 32	87	25 60	2 4	86	34 60	2 35	85	42 60	59
60	0 30	89	8 60	1 0	88	16 60	1 30	87	24 60	2 0	86	32 60	2 31	85	40 60	60
61	0 29	89	7 60	0 59	88	14 60	1 27	87	22 60	1 57	86	30 60	2 26	85	37 60	61
62	0 28	89	6 60	0 57	88	13 60	1 24	87	20 60	1 54	86	28 60	2 21	85	35 60	62
63	0 27	89	6 60	0 55	88	12 60	1 21	87	19 60	1 50	86	26 60	2 17	85	32 60	63
64	0 26	89	5 60	0 53	88	11 60	1 19	87	18 60	1 46	86	24 60	2 12	85	30 60	64
65	0 25	89	5 60	0 51	88	10 60	1 16	87	16 60	1 42	86	22 60	2 8	85	28 60	65
66	0 24	89	4 60	0 49	88	9 60	1 13	87	15 60	1 39	86	20 60	2 3	85	26 60	66
67	0 23	89	4 60	0 47	88	8 60	1 10	87	14 60	1 35	86	18 60	1 58	85	24 60	67
68	0 22	89	3 60	0 45	88	7 60	1 8	87	12 60	1 31	86	17 60	1 53	85	22 60	68
69	0 21	89	3 60	0 43	88	6 60	1 5	87	11 60	1 27	86	15 60	1 48	85	20 60	69
70	0 20	89	3 60	0 41	88	6 60	1 2	87	10 60	1 23	86	14 60	1 43	85	18 60	70
71	0 19	89	2 60	0 39	88	5 60	0 59	87	9 60	1 19	86	12 60	1 39	85	16 60	71
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84	0 6	89	0 60	0 12	88	0 60	0 18	87	1 60	0 24	86	1 60	0 32	85	1 60	84
85	0 5	89	0 60	0 10	88	0 60	0 15	87	0 60	0 20	86	1 60	0 26	85	1 60	85
86	0 4	89	0 60	0 8	88	0 60	0 12	87	0 60	0 16	86	1 60	0 20	85	1 60	86
87	0 3	89	0 60	0 6	88	0 60	0 9	87	0 60	0 12	86	0 60	0 15	85	0 60	87
88	0 2	89	0 60	0 4	88	0 60	0 6	87	0 60	0 8	86	0 60	0 10	85	0 60	88
89	0 1	89	0 60	0 2	88	0 60	0 3	87	0 60	0 4	86	0 60	0 5	85	0 60	89
90	0 0	89	0	0 0	88	0	0 0	87	0	0 0	86	0	0 0	85	0	90

Longitude from Vertex.	LATITUDE OF VERTEX. 6° Lat.	Course.	Dist.	7° Lat.	Course.	Dist.	8° Lat.	Course.	Dist.	9° Lat.	Course.	Dist.	10° Lat.	Course.	Dist.	Longitude from Vertex.
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1	6 0	89 54	60	7 0	89 53	60	8 0	89 52	60	9 0	89 50	59	10 0	89 49	59	1
2	6 0	89 48	60	7 0	89 46	60	8 0	89 44	60	9 0	89 41	59	10 0	89 39	59	2
3	5 59	89 42	60	6 59	89 39	60	7 59	89 36	60	8 59	89 31	59	9 59	89 28	59	3
4	5 59	89 36	60	6 59	89 32	60	7 59	89 27	60	8 59	89 22	59	9 59	89 18	59	4
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6	5 58	89 23	60	6 58	89 17	60	7 57	89 10	60	8 57	89 3	59	9 57	88 57	59	6
7	5 57	89 17	60	6 57	89 10	60	7 56	89 2	60	8 56	88 54	60	9 56	88 47	59	7
8	5 56	89 11	60	6 56	89 3	60	7 55	88 54	60	8 55	88 45	60	9 55	88 37	59	8
9	5 55	89 5	60	6 55	88 56	60	7 54	88 46	60	8 54	88 36	60	9 53	88 27	59	9
10	5 54	88 58	60	6 53	88 48	60	7 53	88 38	60	8 52	88 27	60	9 51	88 16	59	10
11	5 53	88 52	60	6 52	88 41	60	7 51	88 29	60	8 50	88 17	60	9 49	88 5	59	11
12	5 52	88 46	60	6 51	88 34	60	7 50	88 21	60	8 48	88 8	60	9 47	87 55	59	12
13	5 51	88 40	60	6 50	88 26	60	7 48	88 12	60	8 46	87 58	60	9 45	87 45	59	13
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15	5 48	88 27	60	6 46	88 11	60	7 44	87 56	60	8 42	87 40	60	9 40	87 25	60	15
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20	5 39	87 56	60	6 36	87 36	60	7 32	87 16	60	8 29	86 56	60	9 25	86 36	60	20
21	5 37	87 50	60	6 33	87 29	60	7 29	87 8	60	8 26	86 47	60	9 21	86 26	60	21
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30	5 13	87 0	60	6 5	86 30	60	6 57	86 0	60	7 49	85 30	60	8 40	85 1	60	30
31	5 10	86 55	60	6 1	86 24	60	6 53	85 53	60	7 44	85 22	60	8 35	84 52	60	31
32	5 6	86 50	60	5 57	86 18	60	6 49	85 46	60	7 39	85 15	60	8 30	84 43	60	32
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35	4 54	86 34	60	5 44	86 0	60	6 34	85 26	60	7 23	84 52	60	8 13	84 18	60	35
36	4 51	86 28	60	5 40	85 54	60	6 29	85 19	60	7 18	84 44	60	8 7	84 9	60	36
37	4 47	86 23	60	5 36	85 48	60	6 24	85 12	60	7 12	84 36	60	8 1	84 1	60	37
38	4 44	86 18	60	5 32	85 42	60	6 19	85 5	60	7 6	84 28	60	7 55	83 52	60	38
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42	4 28	85 59	60	5 13	85 19	60	5 58	84 40	60	6 42	84 0	60	7 29	83 19	60	42
43	4 24	85 54	60	5 8	85 14	60	5 52	84 34	60	6 35	83 53	60	7 22	83 11	60	43
44	4 20	85 50	60	5 2	85 9	60	5 46	84 28	60	6 28	83 46	60	7 15	83 4	60	44
45	4 15	85 46	60	4 57	85 4	60	5 40	84 22	60	6 22	83 40	60	7 8	82 57	60	45

Longitude from Vertex.	LATITUDE OF VERTEX. 6° Lat.	6° Course.	6° Dist.	7° Lat.	7° Course.	7° Dist.	8° Lat.	8° Course.	8° Dist.	9° Lat.	9° Course.	9° Dist.	10° Lat.	10° Course.	10° Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	4 10	85 41	60	4 51	84 58	60	5 34	84 16	60	6 16	83 33	60	7 0	82 50	60	46
47	4 5	85 37	60	4 46	84 53	60	5 28	84 10	60	6 9	83 27	60	6 52	82 43	60	47
48	4 0	85 32	60	4 41	84 48	60	5 22	84 4	60	6 2	83 21	60	6 44	82 36	60	48
49	3 55	85 28	60	4 36	84 43	60	5 16	83 58	60	5 56	83 13	60	6 36	82 29	60	49
50	3 51	85 24	60	4 31	84 38	60	5 10	83 53	60	5 49	83 7	60	6 28	82 22	60	50
51	3 47	85 20	60	4 25	84 33	60	5 5	83 47	60	5 43	83 1	60	6 20	82 15	60	51
52	3 43	85 16	60	4 20	84 28	60	4 59	83 42	60	5 37	82 55	60	6 12	82 8	60	52
53	3 39	85 12	60	4 15	84 24	60	4 54	83 37	60	5 30	82 49	60	6 4	82 2	60	53
54	3 34	85 8	60	4 10	84 20	60	4 48	83 32	60	5 22	82 43	60	5 55	81 55	60	54
55	3 29	85 4	60	4 5	84 16	60	4 42	83 27	60	5 14	82 38	60	5 46	81 49	60	55
56	3 24	85 0	60	3 59	84 12	60	4 35	83 22	60	5 6	82 33	60	5 38	81 43	60	56
57	3 18	84 57	60	3 53	84 8	60	4 28	83 18	60	4 58	82 28	60	5 30	81 38	60	57
58	3 13	84 54	60	3 47	84 4	60	4 20	83 14	60	4 49	82 23	60	5 21	81 32	60	58
59	3 7	84 51	60	3 40	84 0	60	4 12	83 10	60	4 41	82 18	60	5 12	81 27	60	59
60	3 2	84 48	60	3 33	83 56	60	4 4	83 5	60	4 32	82 13	60	5 3	81 22	60	60
61	2 56	84 45	60	3 27	83 52	60	3 57	83 1	60	4 24	82 8	60	4 54	81 17	60	61
62	2 51	84 42	60	3 20	83 48	60	3 49	82 57	60	4 15	82 3	60	4 44	81 12	60	62
63	2 46	84 39	60	3 13	83 45	60	3 41	82 53	60	4 7	81 59	60	4 35	81 7	60	63
64	2 40	84 36	60	3 6	83 42	60	3 33	82 49	60	3 58	81 55	60	4 25	81 2	60	64
65	2 34	84 33	60	2 59	83 39	60	3 25	82 45	60	3 50	81 51	60	4 16	80 57	60	65
66	2 28	84 30	60	2 52	83 36	60	3 17	82 41	60	3 41	81 47	60	4 7	80 52	60	66
67	2 22	84 27	60	2 45	83 33	60	3 9	82 37	60	3 33	81 43	60	3 57	80 48	60	67
68	2 16	84 25	60	2 38	83 30	60	3 1	82 34	60	3 24	81 39	60	3 47	80 44	60	68
69	2 10	84 23	60	2 31	83 27	60	2 53	82 31	60	3 15	81 35	60	3 37	80 40	60	69
70	2 3	84 21	60	2 24	83 25	60	2 45	82 28	60	3 6	81 32	60	3 27	80 36	60	70
71	1 57	84 19	60	2 17	83 22	60	2 37	82 25	60	2 57	81 29	60	3 17	80 33	60	71
72	1 51	84 17	60	2 10	83 20	60	2 29	82 22	60	2 48	81 26	60	3 7	80 30	60	72
73	1 45	84 15	60	2 3	83 17	60	2 21	82 19	60	2 39	81 23	60	2 57	80 27	60	73
74	1 39	84 13	60	1 56	83 15	60	2 13	82 17	60	2 30	81 20	60	2 47	80 24	60	74
75	1 34	84 11	60	1 49	83 13	60	2 5	82 15	60	2 21	81 18	60	2 37	80 21	60	75
76	1 28	84 9	60	1 42	83 11	60	1 56	82 13	60	2 12	81 16	60	2 26	80 18	60	76
77	1 22	84 8	60	1 35	83 9	60	1 48	82 11	60	2 3	81 14	60	2 16	80 15	60	77
78	1 16	84 7	60	1 28	83 8	60	1 39	82 9	60	1 54	81 12	60	2 5	80 13	60	78
79	1 10	84 6	60	1 20	83 7	60	1 31	82 8	60	1 45	81 10	60	1 55	80 11	60	79
80	1 4	84 5	60	1 13	83 6	60	1 23	82 7	60	1 35	81 8	60	1 45	80 9	60	80
81	0 57	84 4	60	1 6	83 5	60	1 14	82 6	60	1 26	81 6	60	1 34	80 7	60	81
82	0 51	84 3	60	0 58	83 4	60	1 6	82 5	60	1 16	81 5	60	1 24	80 5	60	82
83	0 44	84 2	60	0 51	83 3	60	0 57	82 4	60	1 7	81 4	60	1 13	80 4	60	83
84	0 38	84 1	60	0 44	83 2	60	0 49	82 3	60	0 57	81 3	60	1 3	80 3	60	84
8	0 31	84 1	60	0 36	83 1	60	0 41	82 2	60	0 48	81 2	60	0 52	80 2	61	85
8	0 25	84 1	60	0 28	83 1	60	0 32	82 1	60	0 38	81 1	60	0 42	80 1	61	86
8	0 18	84 0	60	0 21	83 0	60	0 24	82 1	60	0 29	81 1	60	0 32	80 1	61	87
8	0 12	84 0	60	0 14	83 0	60	0 16	82 0	60	0 19	81 0	60	0 21	80 0	61	88
8	0 6	84 0	60	0 7	83 0	60	0 8	82 0	60	0 10	81 0	60	0 11	80 0	61	89
9	0 0	84 0		0 0	83 0		0 0	82 0		0 0	81 0		0 0	80 0		90

Longitude from Vertex.	LATITUDE OF VERTEX. 11° Lat.	11° Course.	11° Dist.	12° Lat.	12° Course.	12° Dist.	13° Lat.	13° Course.	13° Dist.	14° Lat.	14° Course.	14° Dist.	15° Lat.	15° Course.	15° Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	11 0	90 0	59	12 0	90 0	59	13 0	90 0	58	14 0	90 0	58	15 0	90 0	58	0
1	11 0	89 48	59	12 0	89 47	59	13 0	89 46	58	14 0	89 45	58	15 0	89 44	58	1
2	11 0	89 37	59	12 0	89 35	59	13 0	89 33	58	13 59	89 31	58	14 59	89 29	58	2
3	10 59	89 26	59	11 59	89 23	59	12 59	89 19	58	13 59	89 17	58	14 59	89 14	58	3
4	10 59	89 14	59	11 59	89 10	59	12 59	89 6	58	13 58	89 2	58	14 58	88 58	58	4
5	10 58	89 3	59	11 58	88 58	59	12 58	88 52	58	13 57	88 47	58	14 57	88 42	58	5
6	10 56	88 51	59	11 57	88 45	59	12 56	88 39	58	13 56	88 33	58	14 55	88 27	58	6
7	10 54	88 39	59	11 55	88 23	59	12 54	88 25	58	13 54	88 18	58	14 53	88 11	58	7
8	10 52	88 28	59	11 53	88 21	59	12 52	88 12	58	13 52	88 4	58	14 51	87 56	58	8
9	10 51	88 16	59	11 51	88 7	59	12 50	87 58	58	13 50	87 49	58	14 49	87 40	58	9
10	10 50	88 5	59	11 49	87 55	59	12 48	87 45	58	13 48	87 35	58	14 47	87 25	58	10
11	10 48	87 54	59	11 47	87 43	59	12 46	87 32	59	13 45	87 21	58	14 44	87 10	58	11
12	10 46	87 43	59	11 45	87 31	59	12 43	87 19	59	13 42	87 7	58	14 41	86 55	58	12
13	10 44	87 32	59	11 42	87 19	59	12 40	87 6	59	13 39	86 53	58	14 38	86 40	58	13
14	10 41	87 21	59	11 39	87 7	59	12 37	86 53	59	13 36	86 39	58	14 34	86 25	58	14
15	10 38	87 10	59	11 36	86 55	59	12 34	86 40	59	13 32	86 25	58	14 30	86 10	58	15
16	10 35	86 59	59	11 33	86 43	59	12 31	86 27	59	13 28	86 11	59	14 26	85 55	58	16
17	10 32	86 48	59	11 30	86 31	59	12 28	86 14	59	13 24	85 57	59	14 22	85 40	58	17
18	10 29	86 37	59	11 27	86 19	59	12 24	86 1	59	13 20	85 43	59	14 18	85 25	59	18
19	10 26	86 26	59	11 23	86 7	59	12 20	85 48	59	13 16	85 29	59	14 14	85 10	59	19
20	10 22	86 16	59	11 19	85 56	59	12 16	85 36	59	13 12	85 16	59	14 9	84 56	59	20
21	10 18	86 5	59	11 15	85 44	59	12 11	85 23	59	13 7	85 2	59	14 4	84 41	59	21
22	10 14	85 54	59	11 10	85 32	59	12 6	85 10	59	13 2	84 49	59	13 58	84 27	59	22
23	10 10	85 43	59	11 5	85 21	59	12 1	84 58	59	12 57	84 35	59	13 52	84 12	59	23
24	10 5	85 33	59	11 0	85 9	59	11 56	84 45	59	12 51	84 22	59	13 46	83 58	59	24
25	10 0	85 23	59	10 55	84 58	59	11 50	84 33	59	12 45	84 8	59	13 40	83 43	59	25
26	9 55	85 12	60	10 50	84 47	59	11 44	84 20	59	12 39	83 55	59	13 34	83 29	59	26
27	9 50	85 2	60	10 44	84 35	59	11 38	84 8	59	12 33	83 42	59	13 28	83 15	59	27
28	9 45	84 51	60	10 38	84 24	59	11 32	83 56	59	12 26	83 29	59	13 21	83 1	59	28
29	9 39	84 41	60	10 32	84 13	59	11 26	83 44	59	12 19	83 16	59	13 13	82 47	59	29
30	9 33	84 31	60	10 26	84 2	59	11 19	83 32	59	12 12	83 3	59	13 5	82 34	59	30
31	9 27	84 21	60	10 20	83 51	60	11 12	83 20	59	12 5	82 50	59	12 57	82 20	59	31
32	9 21	84 11	60	10 14	83 40	60	11 5	83 8	59	11 57	82 37	59	12 49	82 7	59	32
33	9 15	84 1	60	10 7	83 29	60	10 58	82 56	60	11 49	82 25	59	12 40	81 54	59	33
34	9 9	83 52	60	10 0	83 19	60	10 51	82 45	60	11 41	82 13	59	12 32	81 41	59	34
35	9 3	83 43	60	9 53	83 9	60	10 43	82 35	60	11 33	82 1	59	12 23	81 28	59	35
36	8 57	83 34	60	9 46	82 59	60	10 35	82 24	60	11 25	81 50	60	12 14	81 16	59	36
37	8 50	83 25	60	9 39	82 49	60	10 27	82 13	60	11 17	81 39	60	12 5	81 4	60	37
38	8 43	83 16	60	9 32	82 39	60	10 19	82 2	60	11 8	81 28	60	11 56	80 52	60	38
39	8 36	83 7	60	9 24	82 29	60	10 11	81 52	60	10 59	81 16	60	11 47	80 39	60	39
40	8 29	82 58	60	9 16	82 19	60	10 3	81 42	60	10 50	81 4	60	11 37	80 26	60	40
41	8 22	82 49	60	9 8	82 9	60	9 54	81 32	60	10 41	80 53	60	11 27	80 14	60	41
42	8 14	82 40	60	9 0	82 0	60	9 45	81 22	60	10 32	80 42	60	11 17	80 2	60	42
43	8 6	82 31	60	8 52	81 51	60	9 36	81 12	60	10 22	80 31	60	11 7	79 51	60	43
44	7 58	82 23	60	8 43	81 42	60	9 27	81 2	60	10 12	80 21	60	10 57	79 40	60	44
45	7 50	82 15	60	8 34	81 33	60	9 18	80 52	60	10 2	80 10	60	10 46	79 28	60	45

Longitude from Vertex.	LATITUDE OF VERTEX.															Longitude from Vertex.
	11°			12°			13°			14°			15°			
	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	
46	7 42	82 7	60	8 25	81 24	60	9 8	80 42	60	9 51	79 59	60	10 35	79 17	60	46
47	7 34	81 59	60	8 16	81 15	60	8 58	80 32	60	9 40	79 48	60	10 24	79 6	60	47
48	7 26	81 51	60	8 7	81 6	60	8 48	80 22	60	9 29	79 38	60	10 12	78 55	60	48
49	7 17	81 43	60	7 58	80 58	60	8 38	80 13	60	9 18	79 28	60	10 0	78 44	60	49
50	7 8	81 35	60	7 48	80 50	60	8 28	80 4	60	9 8	79 18	60	9 48	78 33	60	50
51	6 59	81 28	60	7 38	80 42	60	8 18	79 55	60	8 57	79 9	60	9 36	78 23	60	51
52	6 50	81 21	60	7 28	80 34	60	8 7	79 47	60	8 46	79 0	60	9 24	78 13	61	52
53	6 41	81 14	60	7 18	80 26	60	7 56	79 39	60	8 34	78 51	60	9 12	78 4	61	53
54	6 32	81 7	60	7 8	80 19	60	7 45	79 31	60	8 22	78 43	60	8 59	77 55	61	54
55	6 22	81 0	60	6 58	80 12	60	7 34	79 23	60	8 10	78 35	60	8 46	77 46	61	55
56	6 13	80 54	60	6 48	80 5	60	7 23	79 15	60	7 58	78 26	61	8 33	77 37	61	56
57	6 3	80 48	60	6 38	79 58	60	7 12	79 7	60	7 46	78 18	61	8 20	77 28	61	57
58	5 54	80 42	60	6 27	79 51	60	7 0	79 0	60	7 33	78 10	61	8 6	77 19	61	58
59	5 44	80 36	60	6 16	79 44	60	6 48	78 53	61	7 20	78 2	61	7 53	77 11	61	59
60	5 34	80 30	60	6 5	79 38	60	6 36	78 46	61	7 7	77 54	61	7 39	77 3	61	60
61	5 24	80 24	60	5 54	79 32	60	6 24	78 39	61	6 55	77 47	61	7 26	76 55	61	61
62	5 14	80 18	60	5 43	79 26	61	6 12	78 32	61	6 42	77 40	61	7 12	76 47	61	62
63	5 4	80 13	60	5 32	79 20	61	6 0	78 26	61	6 29	77 33	61	6 58	76 40	61	63
64	4 53	80 8	60	5 20	79 14	61	5 48	78 20	61	6 16	77 26	61	6 44	76 33	61	64
65	4 42	80 3	60	5 9	79 8	61	5 36	78 14	61	6 3	77 20	61	6 30	76 26	62	65
66	4 32	79 58	60	4 58	79 3	61	5 24	78 8	61	5 50	77 14	61	6 15	76 20	62	66
67	4 21	79 53	60	4 47	78 58	61	5 11	78 3	61	5 36	77 8	61	6 0	76 14	62	67
68	4 11	79 48	60	4 35	78 53	61	4 58	77 58	61	5 22	77 2	61	5 45	76 8	62	68
69	4 0	79 44	60	4 23	78 48	61	4 45	77 53	61	5 8	76 57	61	5 30	76 2	62	69
70	3 49	79 40	60	4 11	78 44	61	4 32	77 48	61	4 54	76 52	61	5 15	75 56	62	70
71	3 38	79 36	60	3 59	78 40	61	4 19	77 43	61	4 40	76 47	61	5 0	75 51	62	71
72	3 27	79 32	60	3 47	78 36	61	4 6	77 39	61	4 26	76 42	61	4 45	75 46	62	72
73	3 16	79 29	60	3 34	78 32	61	3 52	77 35	61	4 11	76 37	61	4 29	75 41	62	73
74	3 5	79 26	60	3 22	78 28	61	3 39	77 31	61	3 56	76 33	61	4 14	75 36	62	74
75	2 53	79 23	61	3 9	78 25	61	3 26	77 27	61	3 41	76 29	62	3 58	75 32	62	75
76	2 42	79 20	61	2 57	78 22	61	3 12	77 23	61	3 27	76 25	62	3 43	75 28	62	76
77	2 30	79 17	61	2 44	78 19	61	2 59	77 20	61	3 13	76 22	62	3 28	75 24	62	77
78	2 19	79 14	61	2 32	78 16	61	2 46	77 17	61	2 59	76 19	62	3 13	75 20	62	78
79	2 8	79 12	61	2 19	78 13	61	2 32	77 14	61	2 45	76 16	62	2 57	75 17	62	79
80	1 56	79 10	61	2 7	78 11	61	2 19	77 12	62	2 30	76 13	62	2 41	75 14	62	80
81	1 45	79 8	61	1 54	78 9	61	2 6	77 10	62	2 16	76 11	62	2 26	75 12	62	81
82	1 33	79 6	61	1 42	78 7	61	1 52	77 8	62	2 1	76 9	62	2 10	75 10	62	82
83	1 22	79 4	61	1 29	78 5	61	1 38	77 6	62	1 46	76 7	62	1 54	75 8	62	83
84	1 11	79 3	61	1 17	78 4	61	1 24	77 4	62	1 31	76 5	62	1 38	75 6	62	84
☾	0 59	79 2	61	1 4	78 3	61	1 10	77 3	62	1 16	76 3	62	1 22	75 4	62	85
☾	0 48	79 1	61	0 52	78 2	61	0 56	77 2	62	1 1	76 2	62	1 6	75 3	62	86
☾	0 36	79 1	61	0 39	78 1	61	0 42	77 1	62	0 46	76 1	62	0 50	75 2	62	87
☾	0 24	79 0	61	0 26	78 1	61	0 28	77 1	62	0 31	76 1	62	0 33	75 1	62	88
☾	0 12	79 0	61	0 13	78 0	61	0 14	77 0	62	0 16	76 0	62	0 17	75 0	62	89
☾	0 0	79 0		0 0	78 0		0 0	77 0		0 0	76 0		0 0	75 0		90

Longitude from Vertex.	LATITUDE OF VERTEX.															Longitude from Vertex.
	16°			17°			18°			19°			20°			
	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	
	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	
0	16 0	90 0	58	17 0	90 0	57	18 0	90 0	57	19 0	90 0	57	20 0	90 0	56	0
1	16 0	89 43	58	17 0	89 42	57	18 0	89 41	57	19 0	89 40	57	20 0	89 40	56	1
2	15 59	89 26	58	16 59	89 25	57	17 59	89 23	57	18 59	89 21	57	19 59	89 20	56	2
3	15 59	89 10	58	16 58	89 7	57	17 58	89 4	57	18 58	89 1	57	19 58	88 59	57	3
4	15 58	88 53	58	16 57	88 50	58	17 57	88 46	57	18 57	88 42	57	19 57	88 29	57	4
5	15 57	88 37	58	16 56	88 32	58	17 56	88 27	57	18 56	88 22	57	19 56	88 18	57	5
6	15 55	88 20	58	16 54	88 15	58	17 54	88 9	57	18 54	88 3	57	19 54	87 58	57	6
7	15 53	88 4	58	16 52	87 57	58	17 52	87 50	57	18 52	87 44	57	19 52	87 37	57	7
8	15 51	87 48	58	16 50	87 40	58	17 50	87 32	57	18 50	87 24	57	19 50	87 17	57	8
9	15 49	87 32	58	16 48	87 23	58	17 48	87 13	57	18 48	87 5	57	19 48	86 56	57	9
10	15 47	87 15	58	16 45	87 5	58	17 45	86 55	58	18 45	86 45	57	19 45	86 36	57	10
11	15 44	86 59	58	16 42	86 48	58	17 42	86 37	58	18 41	86 26	57	19 41	86 15	57	11
12	15 40	86 43	58	16 38	86 31	58	17 38	86 19	58	18 37	86 7	57	19 37	85 55	57	12
13	15 36	86 27	58	16 34	86 14	58	17 34	86 1	58	18 33	85 48	57	19 32	85 35	57	13
14	15 32	86 11	58	16 30	85 57	58	17 30	85 43	58	18 28	85 29	58	19 27	85 15	57	14
15	15 28	85 55	58	16 26	85 40	58	17 25	85 25	58	18 23	85 10	58	19 22	84 55	57	15
16	15 24	85 39	58	16 22	85 24	58	17 20	85 7	58	18 18	84 51	58	19 17	84 35	58	16
17	15 20	85 23	58	16 18	85 7	58	17 15	84 49	58	18 13	84 32	58	19 12	84 15	58	17
18	15 16	85 7	58	16 13	84 50	58	17 10	84 31	58	18 8	84 13	58	19 6	83 55	58	18
19	15 11	84 51	58	16 8	84 33	58	17 5	84 13	58	18 3	83 54	58	19 0	83 36	58	19
20	15 6	84 36	58	16 3	84 16	58	17 0	83 56	58	17 57	83 36	58	18 54	83 17	58	20
21	15 0	84 20	58	15 57	83 59	58	16 54	83 38	58	17 50	83 17	58	18 47	82 57	58	21
22	14 54	84 4	58	15 51	83 43	58	16 47	83 21	58	17 43	82 59	58	18 40	82 38	58	22
23	14 48	83 49	58	15 44	83 27	58	16 40	83 4	58	17 36	82 41	58	18 32	82 19	58	23
24	14 42	83 34	59	15 37	83 11	58	16 33	82 47	58	17 28	82 23	58	18 24	82 0	58	24
25	14 35	83 19	59	15 30	82 55	59	16 25	82 30	58	17 20	82 5	58	18 16	81 41	58	25
26	14 28	83 4	59	15 23	82 39	59	16 17	82 13	58	17 12	81 47	58	18 7	81 22	58	26
27	14 21	82 49	59	15 15	82 23	59	16 9	81 56	58	17 4	81 29	58	17 58	81 3	58	27
28	14 14	82 34	59	15 7	82 7	59	16 1	81 39	59	16 55	81 12	58	17 49	80 45	58	28
29	14 6	82 19	59	14 59	81 51	59	15 53	81 23	59	16 46	80 55	58	17 40	80 27	58	29
30	13 58	82 5	59	14 51	81 36	59	15 44	81 7	59	16 37	80 38	59	17 30	80 9	58	30
31	13 49	81 51	59	14 42	81 21	59	15 34	80 51	59	16 27	80 21	59	17 20	79 51	58	31
32	13 40	81 37	59	14 33	81 6	59	15 24	80 35	59	16 17	80 4	59	17 9	79 33	58	32
33	13 31	81 23	59	14 24	80 51	59	15 14	80 19	59	16 7	79 47	59	16 58	79 15	58	33
34	13 22	81 9	59	14 14	80 36	59	15 4	80 3	59	15 56	79 30	59	16 47	78 58	59	34
35	13 13	80 55	59	14 4	80 21	59	14 54	79 48	59	15 45	79 14	59	16 36	78 41	59	35
36	13 4	80 41	59	13 54	80 6	59	14 44	79 33	59	15 34	78 58	59	16 24	78 24	59	36
37	12 54	80 27	59	13 44	79 52	59	14 33	79 18	59	15 23	78 42	59	16 12	78 7	59	37
38	12 44	80 14	60	13 34	79 38	59	14 22	79 3	59	15 11	78 26	59	16 0	77 50	59	38
39	12 34	80 1	60	13 23	79 24	60	14 11	78 48	59	14 59	78 10	59	15 48	77 34	59	39
40	12 24	79 48	60	13 12	79 10	60	14 0	78 33	60	14 47	77 55	59	15 35	77 18	59	40
41	12 14	79 35	60	13 1	78 57	60	13 48	78 19	60	14 34	77 40	60	15 22	77 2	60	41
42	12 3	79 23	60	12 50	78 44	60	13 36	78 5	60	14 21	77 25	60	15 8	76 46	60	42
43	11 52	79 11	60	12 38	78 31	60	13 24	77 51	60	14 8	77 10	60	14 54	76 30	60	43
44	11 41	78 59	60	12 26	78 18	60	13 11	77 37	60	13 55	76 55	60	14 40	76 15	60	44
45	11 30	78 47	60	12 14	78 5	60	12 58	77 23	60	13 42	76 41	60	14 26	76 0	60	45

Longitude from Vertex.	LATITUDE OF VERTEX. 16° Lat.	Course.	Dist.	17° Lat.	Course.	Dist.	18° Lat.	Course.	Dist.	19° Lat.	Course.	Dist	20° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	11 18	78 35	60	12 1	77 52	60	12 45	77 10	60	13 28	76 27	60	14 11	75 45	60	46
47	11 6	78 23	60	11 48	77 39	60	12 31	76 57	60	13 14	76 13	60	13 56	75 31	60	47
48	10 54	78 11	60	11 35	77 27	60	12 17	76 44	60	12 59	75 59	60	13 41	75 17	60	48
49	10 41	77 59	60	11 22	77 15	60	12 3	76 31	60	12 44	75 46	60	13 26	75 3	60	49
50	10 28	77 48	61	11 9	77 3	61	11 49	76 18	61	12 29	75 33	61	13 10	74 49	61	50
51	10 15	77 38	61	10 55	76 52	61	11 34	76 6	61	12 14	75 20	61	12 54	74 36	61	51
52	10 2	77 28	61	10 41	76 41	61	11 19	75 54	61	11 58	75 8	61	12 38	74 23	61	52
53	9 49	77 18	61	10 27	76 30	61	11 4	75 43	61	11 42	74 56	61	12 21	74 10	61	53
54	9 36	77 8	61	10 13	76 20	61	10 49	75 32	61	11 26	74 44	61	12 4	73 57	61	54
55	9 22	76 57	61	9 58	76 9	61	10 34	75 21	61	11 10	74 32	61	11 47	73 44	61	55
56	9 8	76 48	61	9 43	75 59	61	10 19	75 10	61	10 54	74 21	61	11 30	73 32	62	56
57	8 54	76 38	61	9 28	75 49	61	10 3	74 59	61	10 38	74 10	62	11 13	73 20	62	57
58	8 40	76 29	61	9 13	75 39	61	9 47	74 48	61	10 21	73 59	62	10 55	73 8	62	58
59	8 26	76 20	61	8 58	75 29	61	9 31	74 38	62	10 4	73 48	62	10 37	72 57	62	59
60	8 11	76 11	61	8 43	75 19	61	9 15	74 28	62	9 47	73 37	62	10 19	72 46	62	60
61	7 57	76 3	61	8 28	75 11	61	8 59	74 19	62	9 30	73 27	62	10 1	72 36	62	61
62	7 42	75 55	61	8 12	75 2	62	8 42	74 10	62	9 12	73 17	62	9 42	72 26	62	62
63	7 27	75 47	61	7 56	74 54	62	8 25	74 1	62	8 54	73 8	62	9 23	72 16	62	63
64	7 12	75 39	62	7 40	74 46	62	8 8	73 52	62	8 36	72 59	62	9 4	72 6	62	64
65	6 57	75 32	62	7 24	74 38	62	7 51	73 44	62	8 18	72 50	62	8 45	71 57	62	65
66	6 42	75 25	62	7 8	74 31	62	7 34	73 36	62	8 0	72 42	62	8 26	71 48	62	66
67	6 26	75 18	62	6 51	74 24	62	7 16	73 29	62	7 41	72 34	62	8 6	71 39	63	67
68	6 10	75 12	62	6 34	74 17	62	6 58	73 22	62	7 22	72 26	62	7 46	71 31	63	68
69	5 53	75 6	62	6 17	74 10	62	6 40	73 15	62	7 3	72 19	63	7 26	71 23	63	69
70	5 37	75 0	62	6 0	74 4	62	6 22	73 8	62	6 44	72 12	63	7 6	71 15	63	70
71	5 20	74 54	62	5 43	73 58	62	6 4	73 2	62	6 24	72 5	63	6 46	71 8	63	71
72	5 4	74 49	62	5 26	73 52	62	5 45	72 56	62	6 4	71 58	63	6 25	71 1	63	72
73	4 47	74 44	62	5 8	73 46	62	5 26	72 50	62	5 44	71 52	63	6 4	70 54	63	73
74	4 31	74 39	62	4 50	73 41	62	5 7	72 44	62	5 24	71 46	63	5 43	70 48	63	74
75	4 14	74 34	62	4 33	73 36	62	4 48	72 38	62	5 4	71 40	63	5 22	70 42	63	75
76	3 58	74 30	62	4 15	73 32	62	4 29	72 33	63	4 44	71 35	63	5 1	70 37	63	76
77	3 41	74 26	62	3 57	73 28	62	4 11	72 29	63	4 24	71 30	63	4 40	70 32	63	77
78	3 25	74 22	62	3 39	73 24	62	3 52	72 25	63	4 5	71 26	63	4 19	70 27	64	78
79	3 8	74 18	62	3 21	73 20	62	3 34	72 21	63	3 45	71 22	63	3 58	70 23	64	79
80	2 52	74 15	62	3 4	73 16	62	3 15	72 17	63	3 25	71 18	63	3 37	70 19	64	80
81	2 35	74 12	62	2 46	73 13	62	2 56	72 14	63	3 5	71 15	63	3 16	70 16	64	81
82	2 18	74 10	62	2 28	73 10	62	2 37	72 11	63	2 45	71 12	63	2 54	70 13	64	82
83	2 1	74 8	62	2 10	73 8	62	2 18	72 9	63	2 25	71 10	64	2 33	70 10	64	83
84	1 44	74 6	62	1 52	73 6	62	1 59	72 7	63	2 5	71 8	64	2 11	70 8	64	84
8	1 27	74 4	62	1 34	73 4	62	1 39	72 5	63	1 44	71 6	64	1 50	70 6	64	85
8	1 10	74 3	62	1 16	73 3	62	1 20	72 4	63	1 24	71 4	64	1 28	70 4	64	86
8	0 53	74 2	62	0 57	73 2	62	1 0	72 3	63	1 3	71 3	64	1 6	70 3	64	87
8	0 35	74 1	62	0 38	73 1	63	0 40	72 2	64	0 42	71 2	64	0 44	70 2	64	88
8	0 18	74 0	62	0 19	73 0	63	0 20	72 1	64	0 21	71 1	64	0 22	70 1	64	89
9	0 0	74 0		0 0	73 0		0 0	72 0		0 0	71 0		0 0	70 0		90

Longitude from Vertex.	LATITUDE OF VERTEX.															Longitude from Vertex.
	21°			22°			23°			24°			25°			
	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	
	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	
0	21 0	90 0	56	22 0	90 0	56	23 0	90 0	55	24 0	90 0	55	25 0	90 0	54	0
1	21 0	89 39	56	22 0	89 38	56	23 0	89 37	55	23 59	89 36	55	24 59	89 35	54	1
2	20 59	89 18	56	21 59	89 16	56	22 59	89 14	55	23 58	89 12	55	24 58	89 10	54	2
3	20 58	88 56	56	21 58	88 53	56	22 58	88 50	56	23 57	88 47	55	24 57	88 45	54	3
4	20 57	88 34	56	21 57	88 31	56	22 57	88 27	56	23 56	88 23	55	24 56	88 19	54	4
5	20 56	88 12	56	21 55	88 8	56	22 56	88 3	56	23 55	87 58	55	24 55	87 53	54	5
6	20 54	87 50	56	21 53	87 45	56	22 54	87 39	56	23 54	87 34	55	24 53	87 28	54	6
7	20 52	87 29	56	21 51	87 22	56	22 52	87 15	56	23 51	87 9	55	24 50	87 3	54	7
8	20 50	87 8	56	21 49	87 0	56	22 49	86 52	56	23 48	86 45	55	24 47	86 38	55	8
9	20 47	86 47	56	21 47	86 38	56	22 46	86 29	56	23 45	86 21	55	24 44	86 13	55	9
10	20 44	86 26	56	21 44	86 16	56	22 43	86 6	56	23 42	85 58	55	24 41	85 48	55	10
11	20 40	86 5	56	21 40	85 55	56	22 39	85 44	56	23 38	85 34	55	24 37	85 23	55	11
12	20 35	85 44	57	21 36	85 33	56	22 35	85 22	56	23 33	85 10	55	24 32	84 58	55	12
13	20 30	85 23	57	21 31	85 11	56	22 30	84 59	56	23 28	84 46	55	24 27	84 33	55	13
14	20 25	85 2	57	21 25	84 49	56	22 24	84 36	56	23 23	84 22	55	24 21	84 8	55	14
15	20 20	84 41	57	21 19	84 27	56	22 18	84 13	56	23 17	83 58	56	24 15	83 43	55	15
16	20 15	84 20	57	21 13	84 5	56	22 12	83 50	56	23 10	83 34	56	24 8	83 18	55	16
17	20 9	83 59	57	21 7	83 43	57	22 6	83 27	56	23 3	83 10	56	24 1	82 54	55	17
18	20 3	83 38	57	21 1	83 21	57	21 59	83 4	56	22 56	82 46	56	23 54	82 29	55	18
19	19 57	83 17	57	20 55	82 59	57	21 52	82 41	56	22 49	82 23	56	23 47	82 5	55	19
20	19 51	82 57	57	20 48	82 38	57	21 45	82 19	56	22 42	82 0	56	23 40	81 41	55	20
21	19 44	82 37	57	20 40	82 17	57	21 37	81 57	56	22 34	81 37	56	23 31	81 17	55	21
22	19 36	82 17	57	20 32	81 56	57	21 29	81 35	57	22 26	81 14	56	23 22	80 53	56	22
23	19 28	81 57	58	20 24	81 35	57	21 21	81 13	57	22 17	80 51	56	23 13	80 29	56	23
24	19 20	81 37	58	20 16	81 14	57	21 12	80 51	57	22 8	80 28	56	23 4	80 6	56	24
25	19 12	81 17	58	20 7	80 53	57	21 3	80 30	57	21 59	80 6	57	22 55	79 43	56	25
26	19 3	80 57	58	19 58	80 32	58	20 53	80 8	57	21 49	79 44	57	22 44	79 20	56	26
27	18 54	80 37	58	19 48	80 12	58	20 43	79 47	57	21 39	79 22	57	22 33	78 57	56	27
28	18 44	80 18	58	19 38	79 52	58	20 33	79 26	57	21 28	79 0	57	22 22	78 34	57	28
29	18 34	79 59	58	19 28	79 32	58	20 23	79 5	58	21 17	78 38	57	22 11	78 11	57	29
30	18 24	79 40	58	19 18	79 13	58	20 12	78 44	58	21 6	78 16	57	22 0	77 48	57	30
31	18 13	79 22	58	19 7	78 53	58	20 0	78 24	58	20 54	77 55	58	21 48	77 26	57	31
32	18 2	79 4	58	18 56	78 34	58	19 48	78 4	58	20 42	77 34	58	21 36	77 4	57	32
33	17 51	78 45	58	18 44	78 14	58	19 36	77 43	58	20 30	77 12	58	21 23	76 42	58	33
34	17 40	78 27	58	18 32	77 55	58	19 24	77 23	58	20 17	76 51	58	21 10	76 20	58	34
35	17 28	78 8	58	18 20	77 35	58	19 12	77 3	58	20 4	76 30	58	20 57	75 58	58	35
36	17 15	77 50	58	18 7	77 16	58	18 58	76 43	58	19 50	76 10	58	20 42	75 37	58	36
37	17 2	77 32	58	17 54	76 58	58	18 44	76 24	58	19 35	75 50	58	20 27	75 16	58	37
38	16 49	77 15	59	17 40	76 40	58	18 30	76 5	58	19 20	75 30	58	20 11	74 55	58	38
39	16 36	76 58	59	17 26	76 22	59	18 16	75 46	59	19 5	75 10	59	19 55	74 34	58	
40	16 23	76 41	59	17 12	76 4	59	18 1	75 27	59	18 50	74 50	59	19 39	74 14	59	
41	16 9	76 24	59	16 57	75 47	59	17 46	75 9	59	18 34	74 31	59	19 23	73 54	59	
42	15 55	76 8	59	16 42	75 30	59	17 31	74 51	59	18 18	74 12	59	19 6	73 34	59	
43	15 41	75 52	59	16 27	75 13	59	17 15	74 33	59	18 2	73 54	59	18 49	73 15	59	
44	15 26	75 36	59	16 12	74 56	59	16 59	74 16	59	17 46	73 36	59	18 32	72 56	59	
45	15 11	75 20	59	15 57	74 40	59	16 43	73 59	59	17 29	73 18	59	18 15	72 37	59	

Longitude from Vertex.	LATITUDE OF VERTEX.															Longitude from Vertex.
	21°			22°			23°			24°			25°			
	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	14 56	75 4	60	15 41	74 23	60	16 26	73 42	60	17 11	73 0	60	17 57	72 18	60	46
47	14 40	74 49	60	15 25	74 7	60	16 9	73 25	60	16 53	72 42	60	17 38	72 0	60	47
48	14 24	74 34	60	15 8	73 51	60	15 52	73 8	60	16 35	72 25	60	17 19	71 42	60	48
49	14 8	74 19	60	14 51	73 35	60	15 34	72 51	60	16 17	72 8	60	17 0	71 24	60	49
50	13 52	74 5	61	14 34	73 20	61	15 16	72 35	61	15 58	71 51	61	16 41	71 6	61	50
51	13 35	73 51	61	14 16	73 5	61	14 57	72 19	61	15 39	71 35	61	16 21	70 49	61	51
52	13 18	73 37	61	13 58	72 50	61	14 38	72 4	61	15 20	71 19	61	16 1	70 33	61	52
53	13 1	73 23	61	13 40	72 36	61	14 19	71 49	61	15 0	71 3	61	15 41	70 17	61	53
54	12 43	73 9	61	13 22	72 22	61	14 0	71 34	61	14 40	70 47	61	15 20	70 1	61	54
55	12 25	72 56	61	13 3	72 8	61	13 41	71 20	61	14 20	70 32	62	14 59	69 45	62	55
56	12 7	72 43	62	12 44	71 55	62	13 21	71 6	62	13 59	70 17	62	14 37	69 30	62	56
57	11 49	72 31	62	12 25	71 42	62	13 1	70 52	62	13 38	70 3	62	14 15	69 15	62	57
58	11 30	72 19	62	12 5	71 29	62	12 41	70 39	62	13 17	69 49	62	13 53	69 0	62	58
59	11 11	72 7	62	11 45	71 16	62	12 20	70 26	62	12 55	69 35	62	13 30	68 46	63	59
60	10 52	71 55	62	11 25	71 4	62	11 59	70 13	62	12 33	69 22	62	13 7	68 32	63	60
61	10 33	71 44	62	11 5	70 53	62	11 38	70 1	62	12 11	69 10	63	12 44	68 19	63	61
62	10 14	71 34	62	10 45	70 42	62	11 17	69 50	63	11 49	68 58	63	12 21	68 6	64	62
63	9 54	71 24	62	10 25	70 31	63	10 55	69 39	63	11 26	68 46	63	11 57	67 53	64	63
64	9 34	71 14	62	10 4	70 20	63	10 33	69 28	63	11 3	68 34	64	11 33	67 41	64	64
65	9 13	71 4	63	9 42	70 10	63	10 11	69 17	63	10 40	68 23	64	11 9	67 29	64	65
66	8 53	70 54	63	9 21	70 0	63	9 49	69 6	63	10 17	68 12	64	10 45	67 18	64	66
67	8 32	70 45	63	8 59	69 50	63	9 26	68 56	64	9 53	68 1	64	10 20	67 7	64	67
68	8 11	70 36	63	8 37	69 41	63	9 3	68 46	64	9 29	67 51	64	9 55	66 56	64	68
69	7 50	70 27	63	8 15	69 32	63	8 40	68 36	64	9 5	67 41	64	9 30	66 46	64	69
70	7 29	70 19	63	7 53	69 23	64	8 17	68 27	64	8 41	67 32	64	9 5	66 36	64	70
71	7 8	70 12	63	7 30	69 15	64	7 53	68 18	64	8 16	67 23	64	8 39	66 27	64	71
72	6 46	70 5	63	7 7	69 8	64	7 29	68 11	64	7 51	67 15	64	8 13	66 18	65	72
73	6 24	69 58	64	6 44	69 1	64	7 5	68 4	64	7 26	67 7	64	7 47	66 10	65	73
74	6 2	69 51	64	6 21	68 54	64	6 41	67 57	64	7 0	66 59	64	7 20	66 2	65	74
75	5 40	69 45	64	5 58	68 47	64	6 16	67 50	64	6 34	66 51	64	6 53	65 54	65	75
76	5 18	69 39	64	5 35	68 41	64	5 52	67 43	64	6 9	66 43	64	6 26	65 46	65	76
77	4 56	69 34	64	5 12	68 35	64	5 28	67 36	64	5 43	66 35	64	5 59	65 38	65	77
78	4 34	69 29	64	4 49	68 29	64	5 3	67 29	64	5 17	66 29	64	5 32	65 31	66	78
79	4 12	69 24	64	4 25	68 24	64	4 38	67 24	64	4 51	66 24	64	5 5	65 25	66	79
80	3 49	69 20	64	4 1	68 20	64	4 13	67 20	64	4 25	66 20	65	4 38	65 20	66	80
81	3 27	69 17	64	3 37	68 17	64	3 48	67 17	64	3 59	66 17	65	4 11	65 17	66	81
82	3 4	69 14	64	3 13	68 14	64	3 23	67 14	64	3 33	66 14	65	3 44	65 14	66	82
83	2 41	69 11	64	2 49	68 11	64	2 58	67 11	64	3 7	66 11	65	3 16	65 11	66	83
84	2 18	69 8	64	2 25	68 8	64	2 33	67 8	64	2 40	66 8	65	2 48	65 8	66	84
8	1 55	69 6	64	2 1	68 6	64	2 8	67 6	65	2 14	66 6	65	2 20	65 6	66	85
8	1 32	69 4	64	1 37	68 4	64	1 42	67 4	65	1 47	66 4	65	1 52	65 4	66	86
8	1 9	69 3	64	1 13	68 3	64	1 17	67 3	65	1 21	66 3	66	1 24	65 3	66	87
8	0 46	69 2	64	0 49	68 2	65	0 51	67 2	65	0 54	66 2	66	0 56	65 2	66	88
8	0 23	69 1	64	0 25	68 1	65	0 26	67 1	65	0 27	66 1	66	0 28	65 1	66	89
9	0 0	69 0		0 0	68 0		0 0	67 0		0 0	66 0		0 0	65 0		90

Longitude from Vertex.	LATITUDE OF VERTEX. 26° Lat.	Course.	Dist.	27° Lat.	Course.	Dist.	28° Lat.	Course.	Dist.	29° Lat.	Course.	Dist.	30° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	26 0	90 0	54	27 0	90 0	53	28 0	90 0	53	29 0	90 0	52	30 0	90 0	52	0
1	25 59	89 34	54	26 59	89 33	53	27 59	89 32	53	28 59	89 31	52	29 59	89 30	52	1
2	25 58	89 8	54	26 58	89 6	54	27 58	89 4	53	28 58	89 2	52	29 58	89 0	52	2
3	25 57	88 42	54	26 57	88 39	54	27 57	88 36	53	28 57	88 33	52	29 57	88 30	52	3
4	25 56	88 16	54	26 56	88 12	54	27 56	88 8	53	28 56	88 4	52	29 56	88 0	52	4
5	25 55	87 48	54	20 54	87 44	54	27 54	87 39	53	28 54	87 34	53	29 54	87 30	52	5
6	25 53	87 22	54	26 52	87 17	54	27 51	87 11	53	28 51	87 5	53	29 51	87 0	52	6
7	25 50	86 56	54	26 49	86 49	54	27 48	86 43	53	28 48	86 36	53	29 48	86 30	52	7
8	25 47	86 30	54	26 46	86 22	54	27 45	86 15	53	28 45	86 7	53	29 45	86 0	52	8
9	25 44	86 4	54	26 43	85 55	54	27 42	85 46	53	28 42	85 39	53	29 41	85 30	52	9
10	25 41	85 38	54	26 40	85 28	54	27 38	85 19	53	28 38	85 10	53	29 37	85 0	52	10
11	25 36	85 12	54	26 35	85 1	54	27 34	84 51	54	28 33	84 41	53	29 32	84 30	52	11
12	25 31	84 46	54	26 30	84 34	54	27 29	84 23	54	28 28	84 12	53	29 27	84 1	52	12
13	25 26	84 20	54	26 24	84 7	54	27 23	83 55	54	28 22	83 43	53	29 21	83 32	53	13
14	25 20	83 54	54	26 18	83 41	54	27 17	83 28	54	28 16	83 15	53	29 15	83 3	53	14
15	25 14	83 29	55	26 12	83 15	54	27 11	83 1	54	28 10	82 47	53	29 9	82 34	53	15
16	25 7	83 3	55	26 5	82 48	54	27 4	82 33	54	28 3	82 19	54	29 2	82 5	53	16
17	25 0	82 38	55	25 58	82 22	54	26 57	82 6	54	27 55	81 51	54	28 54	81 36	53	17
18	24 53	82 12	55	25 51	81 56	54	26 49	81 39	54	27 47	81 23	54	28 46	81 7	53	18
19	24 46	81 47	55	25 44	81 30	55	26 41	81 12	54	27 39	80 55	54	28 38	80 38	53	19
20	24 38	81 22	55	25 36	81 4	55	26 33	80 45	54	27 30	80 27	54	28 29	80 9	53	20
21	24 29	80 57	55	25 27	80 38	55	26 24	80 18	54	27 21	79 59	54	28 19	79 40	54	21
22	24 21	80 32	55	25 18	80 12	55	26 15	79 52	54	27 11	79 31	54	28 9	79 12	54	22
23	24 11	80 8	55	25 9	79 47	55	26 5	79 26	55	27 1	79 4	54	27 59	78 44	54	23
24	24 1	79 44	55	24 59	79 22	55	25 55	79 0	55	26 51	78 37	54	27 48	78 16	54	24
25	23 51	79 20	56	24 49	78 57	55	25 44	78 34	55	26 40	78 10	55	27 37	77 48	54	25
26	23 40	78 56	56	24 37	78 32	55	25 33	78 7	55	26 29	77 43	55	27 25	77 20	55	26
27	23 29	78 32	56	24 25	78 7	56	25 21	77 41	55	26 17	77 16	55	27 13	76 52	55	27
28	23 18	78 8	56	24 13	77 42	56	25 9	77 15	55	26 5	76 50	55	27 0	76 25	55	28
29	23 6	77 44	56	24 1	77 17	56	24 57	76 49	56	25 52	76 24	55	26 47	75 58	55	29
30	22 54	77 21	56	23 49	76 52	56	24 44	76 23	56	25 39	75 58	56	26 34	75 31	55	30
31	22 42	76 58	57	23 36	76 28	56	24 31	75 58	56	25 26	75 33	56	26 20	75 5	56	31
32	22 29	76 35	57	23 23	76 4	56	24 18	75 34	56	25 13	75 7	56	26 6	74 39	56	32
33	22 16	76 12	57	23 10	75 40	57	24 4	75 10	56	24 59	74 41	56	25 51	74 13	56	33
34	22 2	75 49	57	22 57	75 17	57	23 50	74 46	56	24 45	74 16	56	25 36	73 47	56	34
35	21 48	75 26	57	22 43	74 54	57	23 35	74 22	57	24 29	73 51	57	25 20	73 21	56	35
36	21 33	75 4	58	22 27	74 31	57	23 19	73 58	57	24 12	73 26	57	25 3	72 55	57	36
37	21 18	74 43	58	22 10	74 8	58	23 2	73 35	57	23 54	73 2	57	24 46	72 29	57	37
38	21 2	74 22	58	21 53	73 46	58	22 45	73 12	58	23 36	72 38	57	24 28	72 4	57	38
39	20 46	74 1	58	21 36	73 24	58	22 27	72 49	58	23 18	72 14	58	24 10	71 39	58	
40	20 29	73 41	58	21 19	73 3	58	22 9	72 27	58	23 0	71 51	58	23 51	71 15	58	
41	20 12	73 20	59	21 2	72 41	58	21 51	72 5	58	22 41	71 28	58	23 32	70 51	58	
42	19 55	72 59	59	20 44	72 20	59	21 33	71 43	59	22 22	71 5	58	23 13	70 27	58	
43	19 37	72 38	59	20 26	71 59	59	21 15	71 21	59	22 3	70 42	59	22 54	70 4	59	
44	19 19	72 17	59	20 8	71 38	59	20 56	70 59	59	21 44	70 19	59	22 34	69 41	59	
45	19 1	71 57	59	19 49	71 18	59	20 37	70 38	59	21 24	69 57	59	22 13	69 18	59	

Longitude from Vertex.	LATITUDE OF VERTEX. 26° Lat.	Course.	Dist.	27° Lat.	Course.	Dist.	28° Lat.	Course.	Dist.	29° Lat.	Course.	Dist.	30° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	18 42	71 38	60	19 29	70 58	60	20 17	70 17	60	21 4	69 35	60	21 52	68 56	60	46
47	18 23	71 19	60	19 9	70 38	60	19 56	69 56	60	20 43	69 14	60	21 30	68 34	60	47
48	18 4	71 0	60	18 49	70 18	60	19 35	69 35	60	20 21	68 53	60	21 8	68 12	60	48
49	17 45	70 41	60	18 29	69 58	60	19 14	69 15	60	19 59	68 32	60	20 45	67 50	60	49
50	17 25	70 23	61	18 9	69 39	61	18 53	68 55	61	19 37	68 12	61	20 22	67 29	61	50
51	17 4	70 6	61	17 47	69 21	61	18 31	68 36	61	19 14	67 52	61	19 58	67 9	61	51
52	16 43	69 49	61	17 25	69 3	61	18 8	68 18	61	18 51	67 33	61	19 34	66 49	61	52
53	16 22	69 32	61	17 3	68 45	61	17 45	68 0	61	18 27	67 14	62	19 10	66 29	62	53
54	16 1	69 15	62	16 41	68 28	62	17 22	67 42	62	18 3	66 55	62	18 45	66 9	62	54
55	15 39	68 58	62	16 19	68 11	62	16 59	67 24	62	17 39	66 36	62	18 20	65 50	62	55
56	15 16	68 42	62	15 55	67 54	62	16 35	67 7	62	17 14	66 18	63	17 54	65 31	63	56
57	14 53	68 26	62	15 31	67 38	63	16 10	66 50	63	16 48	66 1	63	17 27	65 13	63	57
58	14 30	68 11	63	15 7	67 23	63	15 45	66 34	63	16 22	65 44	63	17 0	64 55	63	58
59	14 6	67 56	63	14 43	67 8	63	15 20	66 18	63	15 56	65 27	64	16 33	64 37	64	59
60	13 42	67 41	63	14 18	66 53	64	14 54	66 2	64	15 30	65 11	64	16 6	64 20	64	60
61	13 18	67 28	64	13 53	66 38	64	14 28	65 47	64	15 3	64 55	64	15 38	64 4	64	61
62	12 54	67 15	64	13 28	66 24	64	14 2	65 33	64	14 36	64 40	64	15 10	63 48	65	62
63	12 29	67 2	64	13 2	66 11	64	13 35	65 19	64	14 8	64 26	65	14 41	63 33	65	63
64	12 4	66 50	64	12 36	65 58	64	13 8	65 5	65	13 40	64 12	65	14 12	63 18	65	64
65	11 39	66 38	64	12 10	65 46	64	12 41	64 52	65	13 12	63 58	65	13 43	63 4	65	65
66	11 14	66 26	64	11 43	65 33	65	12 13	64 39	65	12 43	63 45	65	13 13	62 50	66	66
67	10 48	66 14	64	11 16	65 20	65	11 45	64 26	65	12 14	63 32	66	12 43	62 37	66	67
68	10 22	66 2	64	10 49	65 8	65	11 17	64 13	65	11 45	63 19	66	12 12	62 24	66	68
69	9 56	65 51	65	10 22	64 56	65	10 49	64 1	66	11 15	63 7	66	11 41	62 11	66	69
70	9 30	65 40	65	9 55	64 45	65	10 20	63 49	66	10 45	62 55	66	11 10	61 59	66	70
71	9 3	65 30	65	9 27	64 35	66	9 50	63 39	66	10 14	62 44	66	10 38	61 48	67	71
72	8 36	65 22	65	8 58	64 26	66	9 20	63 30	66	9 43	62 34	66	10 6	61 37	67	72
73	8 8	65 14	65	8 29	64 17	66	8 50	63 21	66	9 12	62 24	66	9 34	61 26	67	73
74	7 40	65 6	65	8 0	64 9	66	8 20	63 12	66	8 41	62 14	67	9 2	61 16	67	74
75	7 12	64 58	65	7 31	64 1	66	7 50	63 3	66	8 10	62 5	67	8 30	61 6	67	75
76	6 44	64 50	66	7 2	63 53	66	7 20	62 54	66	7 38	61 56	67	7 57	60 57	68	76
77	6 16	64 42	66	6 33	63 45	66	6 50	62 46	67	7 6	61 48	67	7 24	60 49	68	77
78	5 48	64 34	66	6 4	63 37	66	6 19	62 39	67	6 34	61 41	67	6 51	60 42	68	78
79	5 20	64 27	66	5 34	63 30	66	5 48	62 32	67	6 2	61 35	67	6 17	60 36	68	79
80	4 51	64 22	66	5 4	63 24	66	5 17	62 26	67	5 30	61 29	68	5 43	60 30	68	80
81	4 22	64 18	66	4 34	63 20	66	4 45	62 21	67	4 57	61 24	68	5 9	60 24	68	81
82	3 53	64 14	66	4 4	63 16	67	4 13	62 17	67	4 24	61 19	68	4 35	60 19	69	82
83	3 24	64 11	66	3 33	63 12	67	3 41	62 13	67	3 51	61 14	68	4 1	60 14	69	83
84	2 55	64 9	66	3 3	63 9	67	3 10	62 10	67	3 18	61 10	68	3 27	60 10	69	84
	2 26	64 7	66	2 32	63 7	67	2 38	62 7	67	2 45	61 7	68	2 53	60 7	69	85
	1 57	64 5	66	2 2	63 5	67	2 6	62 5	67	2 12	61 5	68	2 19	60 5	69	86
	1 28	64 3	67	1 31	63 3	67	1 35	62 3	67	1 39	61 3	68	1 44	60 3	69	87
	0 59	64 2	67	1 1	63 2	67	1 3	62 2	68	1 6	61 2	68	1 9	60 2	69	88
	0 30	64 1	67	0 31	63 1	67	0 32	62 1	68	0 33	61 1	69	0 35	60 1	69	89
	0 0	64 0		0 0	63 0		0 0	62 0		0 0	61 0		0 0	60 0		90

Longitude from Vertex.	LATITUDE OF VERTEX.															Longitude from Vertex.
	31°			32°			33°			34°			35°			
	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	31 0	90 0	51	32 0	90 0	51	33 0	90 0	50	34 0	90 0	50	35 0	90 0	49	0
1	30 59	89 29	51	31 59	89 28	51	32 59	89 27	50	33 59	89 26	50	34 59	89 25	49	1
2	30 58	88 58	52	31 58	88 56	51	32 58	88 54	50	33 58	88 52	50	34 58	88 50	49	2
3	30 57	88 27	52	31 57	88 24	51	32 57	88 22	50	33 57	88 19	50	34 57	88 16	49	3
4	30 56	87 56	52	31 56	87 52	51	32 56	87 49	50	33 56	87 45	50	34 55	87 42	49	4
5	30 54	87 25	52	31 54	87 21	51	32 54	87 16	51	33 54	87 12	50	34 53	87 8	49	5
6	30 52	86 55	52	31 51	86 49	51	32 51	86 44	51	33 51	86 39	50	34 50	86 34	49	6
7	30 49	86 24	52	31 48	86 17	51	32 48	86 12	51	33 48	86 6	50	34 47	86 0	49	7
8	30 45	85 53	52	31 44	85 45	52	32 44	85 39	51	33 44	85 32	50	34 43	85 26	49	8
9	30 41	85 22	52	31 40	85 14	52	32 40	85 7	51	33 40	84 59	50	34 39	84 52	49	9
10	30 37	84 52	52	31 36	84 42	52	32 35	84 34	51	33 35	84 25	50	34 35	84 18	50	10
11	30 32	84 21	52	31 31	84 11	52	32 30	84 1	51	33 30	83 52	50	34 29	83 44	50	11
12	30 26	83 51	52	31 25	83 40	52	32 24	83 29	51	33 25	83 19	50	34 23	83 10	50	12
13	30 20	83 21	52	31 19	83 9	52	32 18	82 57	51	33 19	82 46	51	34 17	82 36	50	13
14	30 14	82 51	52	31 13	82 38	52	32 12	82 25	51	33 12	82 13	51	34 11	82 2	50	14
15	30 8	82 21	52	31 7	82 7	52	32 6	81 54	52	33 5	81 41	51	34 4	81 28	50	15
16	30 1	81 51	52	31 0	81 36	52	31 59	81 23	52	32 58	81 8	51	33 57	80 54	50	16
17	29 53	81 21	52	30 52	81 5	52	31 51	80 51	52	32 50	80 35	51	33 49	80 20	50	17
18	29 45	80 51	53	30 43	80 34	52	31 42	80 19	52	32 41	80 3	51	33 40	79 47	50	18
19	29 36	80 21	53	30 34	80 4	52	31 33	79 48	52	32 32	79 31	51	33 31	79 14	51	19
20	29 27	79 52	53	30 25	79 34	53	31 23	79 16	52	32 22	78 59	52	33 21	78 41	51	20
21	29 17	79 22	53	30 15	79 4	53	31 13	78 45	52	32 12	78 27	52	33 11	78 8	51	21
22	29 7	78 53	53	30 4	78 34	53	31 2	78 14	52	32 1	77 55	52	33 0	77 35	51	22
23	28 56	78 24	53	29 53	78 4	53	30 51	77 43	53	31 50	77 23	52	32 48	77 2	51	23
24	28 45	77 55	53	29 42	77 34	53	30 40	77 12	53	31 38	76 51	52	32 36	76 30	52	24
25	28 34	77 26	54	29 31	77 4	53	30 28	76 42	53	31 26	76 20	52	32 24	75 58	52	25
26	28 22	76 57	54	29 19	76 35	53	30 16	76 11	53	31 13	75 49	53	32 11	75 26	52	26
27	28 9	76 29	54	29 6	76 6	54	30 3	75 41	53	31 0	75 18	53	31 58	74 54	52	27
28	27 56	76 1	54	28 53	75 37	54	29 50	75 12	53	30 47	74 47	53	31 44	74 22	53	28
29	27 43	75 33	54	28 40	75 8	54	29 36	74 42	54	30 33	74 17	53	31 29	73 51	53	29
30	27 30	75 5	55	28 26	74 39	54	29 22	74 13	54	30 18	73 47	53	31 14	73 20	53	30
31	27 16	74 37	55	28 11	74 11	54	29 7	73 44	54	30 2	73 17	54	30 58	72 49	53	31
32	27 1	74 10	55	27 56	73 43	55	28 51	73 15	54	29 46	72 47	54	30 41	72 18	54	32
33	26 46	73 43	55	27 40	73 15	55	28 35	72 46	54	29 30	72 17	54	30 24	71 48	54	33
34	26 31	73 16	55	27 24	72 47	55	28 19	72 17	55	29 13	71 47	54	30 7	71 18	54	34
35	26 15	72 49	56	27 8	72 19	55	28 2	71 48	55	28 56	71 18	54	29 50	70 48	54	35
36	25 58	72 23	56	26 51	71 52	55	27 45	71 20	55	28 38	70 49	55	29 32	70 18	55	36
37	25 40	71 57	56	26 33	71 25	56	27 27	70 52	55	28 19	70 20	55	29 13	69 49	55	37
38	25 21	71 31	56	26 14	70 58	56	27 8	70 24	56	28 0	69 52	55	28 53	69 20	55	38
39	25 2	71 5	57	25 55	70 31	56	26 48	69 57	56	27 40	69 24	56	28 33	68 51	56	9
40	24 43	70 40	57	25 35	70 5	56	26 27	69 30	56	27 20	68 56	56	28 13	68 22	56	0
41	24 23	70 16	57	25 15	69 40	57	26 6	69 4	56	26 59	68 29	56	27 52	67 54	56	1
42	24 3	69 52	57	24 55	69 15	57	25 45	68 38	57	26 37	68 2	57	27 30	67 26	57	2
43	23 43	69 28	58	24 34	68 50	57	25 24	68 12	57	26 15	67 35	57	27 7	66 58	57	3
44	23 23	69 4	58	24 13	68 25	58	25 3	67 47	57	25 53	67 9	57	26 44	66 31	57	4
45	23 3	68 40	59	23 52	68 1	58	24 41	67 22	58	25 30	66 43	58	26 20	66 4	58	5

Longitude from Vertex.	LATITUDE OF VERTEX. 31° Lat.	31° Course.	31° Dist.	32° Lat.	32° Course.	32° Dist.	33° Lat.	33° Course.	33° Dist.	34° Lat.	34° Course.	34° Dist.	35° Lat.	35° Course.	35° Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	22 42	68 17	59	23 30	67 37	58	24 17	66 57	58	25 6	66 18	58	25 55	65 38	58	46
47	22 20	67 54	59	23 7	67 14	59	23 53	66 32	58	24 41	65 53	58	25 30	65 12	58	47
48	21 57	67 31	59	22 43	66 51	59	23 29	66 8	59	24 16	65 28	59	25 5	64 46	59	48
49	21 32	67 9	60	22 18	66 28	59	23 4	65 44	59	23 51	65 3	59	24 40	64 21	59	49
50	21 7	66 47	60	21 53	66 5	60	22 39	65 21	59	23 26	64 39	59	24 14	63 56	59	50
51	20 42	66 26	60	21 28	65 43	60	22 13	64 58	60	23 0	64 15	60	23 47	63 32	60	51
52	20 17	66 5	61	21 2	65 21	60	21 47	64 36	60	22 33	63 52	60	23 19	63 8	60	52
53	19 52	65 44	61	20 36	64 59	61	21 20	64 14	61	22 6	63 29	61	22 51	62 45	61	53
54	19 27	65 23	62	20 10	64 37	61	20 53	63 53	61	21 38	63 7	61	22 22	62 22	61	54
55	19 2	65 3	62	19 43	64 17	62	20 26	63 32	62	21 10	62 45	62	21 53	61 59	62	55
56	18 36	64 44	63	19 16	63 57	62	19 58	63 11	62	20 41	62 24	62	21 22	61 37	62	56
57	18 9	64 25	63	18 48	63 37	63	19 29	62 51	63	20 11	62 3	63	20 52	61 16	63	57
58	17 41	64 6	63	18 20	63 18	63	18 59	62 31	63	19 41	61 42	63	20 21	60 55	63	58
59	17 12	63 48	64	17 51	62 59	64	18 29	62 11	64	19 10	61 22	64	19 50	60 34	64	59
60	16 43	63 31	64	17 22	62 40	64	18 0	61 52	64	18 39	61 3	64	19 18	60 13	64	60
61	16 14	63 14	64	16 52	62 22	64	17 30	61 34	64	18 7	60 44	64	18 46	59 53	64	61
62	15 45	62 58	65	16 22	62 5	65	16 59	61 16	65	17 34	60 26	65	18 13	59 34	65	62
63	15 15	62 42	65	15 51	61 48	65	16 27	60 59	65	17 1	60 8	65	17 39	59 15	65	63
64	14 45	62 26	65	15 20	61 32	65	15 54	60 42	66	16 28	59 50	66	17 4	58 57	66	64
65	14 15	62 10	66	14 48	61 17	66	15 21	60 25	66	15 55	59 33	66	16 29	58 40	66	65
66	13 44	61 55	66	14 16	61 3	66	14 48	60 10	66	15 21	59 17	66	15 53	58 23	67	66
67	13 13	61 41	66	13 43	60 49	66	14 14	59 55	67	14 46	59 1	67	15 17	58 7	67	67
68	12 41	61 28	66	13 10	60 35	67	13 40	59 40	67	14 11	58 46	67	14 41	57 52	67	68
69	12 9	61 16	67	12 37	60 22	67	13 6	59 27	67	13 36	58 32	67	14 5	57 37	68	69
70	11 37	61 4	67	12 4	60 9	67	12 32	59 14	68	13 0	58 19	68	13 28	57 23	68	70
71	11 4	60 53	67	11 30	59 57	67	11 57	59 1	68	12 23	58 6	68	12 50	57 10	68	71
72	10 31	60 42	67	10 56	59 45	68	11 21	58 49	68	11 46	57 53	68	12 12	56 57	69	72
73	9 58	60 31	67	10 22	59 34	68	10 45	58 37	68	11 9	57 41	69	11 34	56 45	69	73
74	9 25	60 20	68	9 47	59 23	68	10 9	58 26	69	10 32	57 30	69	10 55	56 33	69	74
75	8 51	60 10	68	9 12	59 13	68	9 33	58 16	69	9 55	57 19	69	10 16	56 22	70	75
76	8 17	60 1	68	8 36	59 4	69	8 56	58 7	69	9 17	57 10	70	9 37	56 12	70	76
77	7 43	59 53	68	8 1	58 56	69	8 19	57 58	69	8 39	57 1	70	8 58	56 3	71	77
78	7 8	59 45	69	7 25	58 48	69	7 42	57 50	70	8 1	56 52	71	8 19	55 54	71	78
79	6 33	59 38	69	6 49	58 40	69	7 5	57 42	70	7 23	56 43	71	7 39	55 45	71	79
80	5 58	59 32	69	6 13	58 32	69	6 28	57 34	70	6 44	56 35	71	6 59	55 36	72	80
81	5 22	59 26	69	5 37	58 26	70	5 50	57 26	71	6 4	56 28	71	6 18	55 28	72	81
82	4 47	59 21	69	5 0	58 20	70	5 11	57 20	71	5 24	56 22	72	5 36	55 21	72	82
83	4 11	59 16	69	4 22	58 15	70	4 32	57 15	71	4 43	56 17	72	4 54	55 16	73	83
84	3 35	59 12	69	3 45	58 11	70	3 53	57 11	71	4 3	56 13	72	4 12	55 12	73	84
8	2 59	59 8	69	3 7	58 8	70	3 14	57 8	71	3 22	56 9	72	3 30	55 9	73	85
8	2 24	59 6	69	2 30	58 6	70	2 35	57 6	71	2 42	56 6	72	2 48	55 7	73	86
8	1 48	59 4	70	1 53	58 4	71	1 57	57 4	72	2 2	56 4	72	2 6	55 5	73	87
8	1 12	59 2	70	1 15	58 2	71	1 18	57 2	72	1 21	56 2	72	1 24	55 3	73	88
8	0 36	59 1	70	0 38	58 1	71	0 39	57 1	72	0 41	56 1	72	0 42	55 1	73	89
9	0 0	59 0		0 0	58 0		0 0	57 0		0 0	56 0		0 0	55 0		90

Longitude from Vertex.	LATITUDE OF VERTEX. 36° Lat.	Course.	Dist.	37° Lat.	Course.	Dist.	38° Lat.	Course.	Dist.	39° Lat.	Course.	Dist.	40° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	36 0	90 0	49	37 0	90 0	48	38 0	90 0	47	39 0	90 0	47	40 0	90 0	46	0
1	35 59	89 24	49	36 59	89 23	48	37 59	89 22	47	38 59	89 22	47	39 59	89 21	46	1
2	35 58	88 48	49	36 58	88 46	48	37 58	88 44	47	38 58	88 44	47	39 58	88 42	46	2
3	35 57	88 13	49	36 57	88 10	48	37 57	88 8	47	38 57	88 6	47	39 57	88 3	46	3
4	35 55	87 38	49	36 55	87 34	48	37 55	87 31	47	38 55	87 28	47	39 55	87 25	46	4
5	35 53	87 3	49	36 53	86 58	48	37 53	86 55	47	38 53	86 50	47	39 53	86 47	46	5
6	35 50	86 28	49	36 50	86 22	48	37 50	86 18	47	38 50	86 13	47	39 50	86 8	46	6
7	35 47	85 54	49	36 47	85 47	48	37 47	85 41	47	38 47	85 36	47	39 47	85 30	46	7
8	35 44	85 19	49	36 44	85 12	49	37 43	85 5	47	38 43	84 58	47	39 43	84 52	46	8
9	35 40	84 44	49	36 40	84 36	49	37 39	84 28	48	38 39	84 21	47	39 39	84 13	46	9
10	35 35	84 9	49	36 35	84 1	49	37 34	83 52	48	38 34	83 44	47	39 34	83 35	46	10
11	35 29	83 34	49	36 29	83 25	49	37 28	83 15	48	38 28	83 7	47	39 28	82 57	47	11
12	35 23	83 0	49	36 23	82 49	49	37 22	82 39	48	38 22	82 30	47	39 21	82 19	47	12
13	35 17	82 25	49	36 17	82 14	49	37 16	82 2	48	38 15	81 52	47	39 14	81 41	47	13
14	35 10	81 50	49	36 10	81 39	49	37 9	81 26	48	38 8	81 15	47	39 7	81 3	47	14
15	35 3	81 15	50	36 3	81 3	49	37 2	80 50	49	38 1	80 38	48	39 0	80 26	47	15
16	34 55	80 41	50	35 55	80 27	49	36 54	80 14	49	37 53	80 1	48	38 52	79 48	47	16
17	34 47	80 6	50	35 47	79 52	49	36 45	79 38	49	37 44	79 24	48	38 43	79 10	48	17
18	34 38	79 32	50	35 38	79 18	49	36 36	79 2	49	37 35	78 47	48	38 34	78 33	48	18
19	34 29	78 58	50	35 28	78 43	50	36 27	78 26	49	37 26	78 10	48	38 25	77 55	48	19
20	34 20	78 24	50	35 18	78 8	50	36 17	77 50	49	37 16	77 34	49	38 15	77 18	48	20
21	34 10	77 50	50	35 8	77 33	50	36 6	77 15	49	37 5	76 58	49	38 4	76 41	48	21
22	33 59	77 16	51	34 57	76 58	50	35 55	76 40	50	36 54	76 22	49	37 53	76 4	48	22
23	33 47	76 43	51	34 45	76 24	50	35 43	76 5	50	36 43	75 46	49	37 41	75 27	49	23
24	33 35	76 10	51	34 33	75 50	50	35 31	75 30	50	36 30	75 10	49	37 28	74 50	49	24
25	33 22	75 37	51	34 20	75 16	51	35 18	74 55	50	36 17	74 35	50	37 15	74 14	49	25
26	33 8	75 4	52	34 6	74 42	51	35 4	74 20	50	36 3	74 0	50	37 1	73 38	49	26
27	32 54	74 31	52	33 52	74 8	51	34 50	73 46	51	35 49	73 25	50	36 47	73 2	50	27
28	32 40	73 58	52	33 37	73 35	52	34 35	73 12	51	35 34	72 50	51	36 32	72 26	50	28
29	32 25	73 26	53	33 22	73 2	52	34 20	72 38	51	35 18	72 15	51	36 16	71 50	50	29
30	32 10	72 55	53	33 7	72 29	52	34 4	72 4	52	35 2	71 40	51	36 0	71 15	51	30
31	31 54	72 23	53	32 51	71 57	53	33 48	71 30	52	34 45	71 5	52	35 44	70 40	51	31
32	31 38	71 52	53	32 35	71 25	53	33 31	70 57	53	34 28	70 30	52	35 27	70 5	52	32
33	31 21	71 20	54	32 18	70 52	53	33 14	70 24	53	34 11	69 56	53	35 9	69 30	52	33
34	31 4	70 49	54	32 0	70 19	54	32 56	69 51	53	33 53	69 23	53	34 50	68 56	53	34
35	30 46	70 18	54	31 42	69 48	54	32 38	69 19	54	33 34	68 50	53	34 30	68 22	53	35
36	30 27	69 48	55	31 23	69 17	54	32 19	68 47	54	33 14	68 17	54	34 9	67 48	54	36
37	30 8	69 17	55	31 3	68 46	55	31 59	68 15	54	32 54	67 45	54	33 49	67 15	54	37
38	29 48	68 47	55	30 43	68 15	55	31 38	67 43	55	32 33	67 13	55	33 28	66 42	55	38
39	29 27	68 17	56	30 22	67 45	55	31 16	67 12	55	32 11	66 41	55	33 6	66 9	55	39
40	29 6	67 48	56	30 0	67 15	56	30 54	66 42	55	31 49	66 9	55	32 44	65 36	55	40
41	28 44	67 19	56	29 38	66 46	56	30 32	66 12	56	31 27	65 38	56	32 22	65 4	56	41
42	28 21	66 51	57	29 15	66 16	57	30 9	65 42	56	31 4	65 8	56	31 59	64 32	56	42
43	27 58	66 22	57	28 51	65 47	57	29 45	65 12	57	30 40	64 37	57	31 35	64 0	57	43
44	27 35	65 54	57	28 27	65 18	57	29 21	64 42	57	30 15	64 6	57	31 9	63 29	57	44
45	27 11	65 26	58	28 3	64 49	58	28 56	64 12	58	29 49	63 35	58	30 42	62 58	58	45

Longitude from Vertex.	LATITUDE OF VERTEX. 36° Lat.	Course.	Dist.	37° Lat.	Course.	Dist.	38° Lat.	Course.	Dist.	39° Lat.	Course.	Dist.	40° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	26 46	64 59	58	27 38	64 21	58	28 30	63 43	58	29 22	63 5	58	30 14	62 28	58	46
47	26 21	64 32	58	27 12	63 54	58	28 4	63 15	59	28 55	62 35	59	29 46	61 58	59	47
48	25 55	64 6	59	26 46	63 27	59	27 38	62 47	59	28 28	62 6	59	29 18	61 28	59	48
49	25 29	63 40	59	26 19	63 0	59	27 10	62 19	59	28 0	61 38	59	28 50	60 59	60	49
50	25 2	63 14	59	25 51	62 33	59	26 41	61 52	60	27 31	61 11	60	28 21	60 30	60	50
51	24 34	62 49	60	25 22	62 7	60	26 12	61 26	60	27 1	60 44	60	27 51	60 2	61	51
52	24 5	62 24	60	24 53	61 42	60	25 42	61 0	60	26 30	60 17	61	27 20	59 34	61	52
53	23 36	62 0	61	24 23	61 17	61	25 11	60 34	61	25 58	59 50	61	26 47	59 7	62	53
54	23 7	61 36	61	23 53	60 52	61	24 39	60 8	61	25 26	59 24	62	26 14	58 40	63	54
55	22 37	61 13	62	23 22	60 28	62	24 7	59 43	62	24 53	58 58	63	25 41	58 13	64	55
56	22 6	60 50	63	22 50	60 5	63	23 34	59 18	63	24 20	58 33	64	25 8	57 46	65	56
57	21 34	60 28	63	22 17	59 42	63	23 1	58 54	64	23 46	58 8	64	24 34	57 20	65	57
58	21 2	60 7	64	21 44	59 20	64	22 28	58 31	64	23 12	57 44	65	23 59	56 56	66	58
59	20 29	59 47	64	21 11	58 58	64	21 54	58 9	65	22 38	57 21	65	23 23	56 33	66	59
60	19 56	59 27	64	20 38	58 37	65	21 20	57 48	65	22 3	57 0	66	22 46	56 11	67	60
61	19 22	59 6	65	20 4	58 17	65	20 44	57 28	66	21 27	56 40	66	22 8	55 50	67	61
62	18 48	58 46	65	19 29	57 57	66	20 8	57 8	66	20 50	56 20	67	21 29	55 30	68	62
63	18 13	58 26	66	18 53	57 38	66	19 31	56 48	67	20 11	56 0	67	20 50	55 10	68	63
64	17 38	58 7	66	18 16	57 19	67	18 53	56 29	67	19 31	55 40	68	20 10	54 50	69	64
65	17 3	57 48	67	17 38	57 0	67	18 14	56 10	68	18 51	55 20	68	19 29	54 30	69	65
66	16 27	57 30	67	17 0	56 42	68	17 35	55 51	68	18 11	55 0	69	18 48	54 10	70	66
67	15 50	57 13	67	16 22	56 24	68	16 56	55 32	69	17 31	54 41	69	18 6	53 50	70	67
68	15 12	56 56	68	15 44	56 6	69	16 17	55 13	69	16 50	54 22	70	17 24	53 30	71	68
69	14 34	56 41	68	15 6	55 49	69	15 37	54 55	70	16 9	54 3	70	16 42	53 10	71	69
70	13 56	56 27	68	14 27	55 33	70	14 56	54 38	70	15 27	53 44	71	16 0	52 50	72	70
71	13 17	56 13	69	13 46	55 18	70	14 14	54 22	71	14 45	53 27	71	15 17	52 33	72	71
72	12 37	56 0	69	13 5	55 4	71	13 32	54 8	71	14 2	53 12	72	14 33	52 17	73	72
73	11 57	55 47	69	12 24	54 51	71	12 50	53 55	72	13 18	52 58	72	13 48	52 3	73	73
74	11 17	55 35	70	11 43	54 39	72	12 7	53 43	72	12 34	52 45	73	13 2	51 50	74	74
75	10 37	55 24	70	11 1	54 28	72	11 24	53 31	73	11 50	52 33	73	12 15	51 38	74	75
76	9 57	55 13	71	10 19	54 17	73	10 41	53 19	73	11 5	52 22	74	11 28	51 26	75	76
77	9 17	55 3	71	9 37	54 6	73	9 58	53 8	74	10 19	52 11	74	10 41	51 15	75	77
78	8 37	54 53	72	8 55	53 55	73	9 15	52 57	74	9 32	52 0	75	9 53	51 4	76	78
79	7 56	54 44	72	8 13	53 46	74	8 31	52 48	75	8 54	51 51	75	9 5	50 54	76	79
80	7 14	54 36	73	7 30	53 38	74	7 45	52 40	75	8 6	51 42	76	8 17	50 44	77	80
81	6 31	54 29	73	6 46	53 31	74	6 59	52 32	76	7 17	51 33	76	7 28	50 35	77	81
82	5 48	54 22	73	6 1	53 24	74	6 13	52 24	76	6 29	51 26	77	6 39	50 27	77	82
83	5 5	54 16	73	5 16	53 18	75	5 27	52 17	76	5 41	51 20	77	5 50	50 20	77	83
84	4 21	54 12	74	4 31	53 14	75	4 41	52 13	76	4 52	51 15	77	5 1	50 15	78	84
8:	3 38	54 9	74	3 46	53 11	75	3 54	52 10	76	4 3	51 11	77	4 12	50 11	78	85
8(	2 54	54 7	74	3 1	53 8	75	3 8	52 8	77	3 15	51 8	77	3 22	50 8	78	86
8;	2 11	54 5	74	2 16	53 6	75	2 21	52 6	77	2 27	51 6	78	2 32	50 6	78	87
8(	1 27	54 3	74	1 31	53 4	76	1 34	52 4	77	1 38	51 4	78	1 42	50 4	78	88
8;	0 44	54 1	74	0 46	53 2	76	0 47	52 2	77	0 49	51 2	78	0 51	50 2	78	89
9(	0 0	54 0		0 0	53 0		0 0	52 0		0 0	51 0		0 0	50 0		90

Longitude from Vertex.	LATITUDE OF VERTEX. 41° Lat.	Course.	Dist.	42° Lat.	Course.	Dist.	43° Lat.	Course.	Dist.	44° Lat.	Course.	Dist.	45° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	41 0	90 0	45	42 0	90 0	45	43 0	90 0	44	44 0	90 0	43	45 0	90 0	42	0
1	40 59	89 20	45	41 59	89 19	45	42 59	89 18	44	43 59	89 18	43	44 59	89 17	42	1
2	40 58	88 39	45	41 58	88 39	45	42 58	88 37	44	43 58	88 36	43	44 58	88 34	42	2
3	40 57	88 0	45	41 57	87 59	45	42 57	87 56	44	43 57	87 54	43	44 57	87 52	42	3
4	40 55	87 21	45	41 55	87 19	45	42 55	87 16	44	43 55	87 12	43	44 56	87 10	42	4
5	40 53	86 42	45	41 53	86 39	45	42 53	86 35	44	43 53	86 30	43	44 54	86 28	42	5
6	40 50	86 3	46	41 50	85 59	45	42 50	85 55	44	43 50	85 48	43	44 52	85 46	43	6
7	40 47	85 24	46	41 47	85 19	45	42 47	85 14	45	43 47	85 7	44	44 48	85 4	43	7
8	40 43	84 45	46	41 43	84 39	45	42 43	84 34	45	43 43	84 26	44	44 44	84 22	43	8
9	40 39	84 6	46	41 39	83 59	45	42 39	83 53	45	43 39	83 45	44	44 39	83 40	43	9
10	40 34	83 27	46	41 34	83 19	45	42 34	83 13	45	43 34	83 4	44	44 34	82 57	43	10
11	40 28	82 48	46	41 28	82 39	46	42 28	82 32	45	43 28	82 23	44	44 28	82 15	43	11
12	40 21	82 9	46	41 21	81 59	46	42 21	81 52	45	43 22	81 42	44	44 21	81 33	44	12
13	40 14	81 30	46	41 14	81 19	46	42 14	81 11	45	43 15	81 1	45	44 14	80 50	44	13
14	40 8	80 52	46	41 7	80 39	46	42 7	80 29	45	43 8	80 20	45	44 7	80 8	44	14
15	40 0	80 13	47	41 0	80 0	46	42 0	79 49	46	43 0	79 39	45	44 0	79 26	44	15
16	39 51	79 34	47	40 52	79 20	46	41 52	79 8	46	42 51	78 58	45	43 52	78 44	44	16
17	39 42	78 55	47	40 43	78 40	46	41 43	78 28	46	42 42	78 18	45	43 43	78 2	45	17
18	39 33	78 16	47	40 33	78 1	47	41 33	77 47	46	42 32	77 37	46	43 32	77 20	45	18
19	39 24	77 38	47	40 23	77 22	47	41 22	77 7	46	42 22	76 57	46	43 22	76 38	45	19
20	39 14	77 0	48	40 13	76 43	47	41 12	76 26	47	42 11	76 [illegible]	46	43 11	75 57	45	20
21	39 3	76 22	48	40 2	76 5	47	41 1	75 56	47	42 0	75 [illegible]	46	43 0	75 16	46	21
22	38 52	75 45	48	39 51	75 27	48	40 50	75 17	47	41 49	74 56	46	42 49	74 36	46	22
23	38 40	75 8	48	39 39	74 49	48	40 38	74 37	47	41 37	74 16	47	42 37	73 56	46	23
24	38 27	74 31	48	39 26	74 11	48	40 25	73 58	48	41 24	73 36	47	42 24	73 16	47	24
25	38 14	73 54	49	39 12	73 34	48	40 12	73 19	48	41 11	72 56	47	42 10	72 37	47	25
26	38 0	73 17	49	38 58	72 57	49	39 58	72 40	48	40 57	72 16	48	41 56	71 57	47	26
27	37 45	72 40	49	38 43	72 20	49	39 43	72 1	49	40 42	71 37	48	41 41	71 17	48	27
28	37 30	72 4	49	38 28	71 43	49	39 28	71 22	49	40 27	70 58	49	41 26	70 37	48	28
29	37 14	71 28	50	38 13	71 6	50	39 12	70 43	49	40 11	70 19	49	41 10	69 58	48	29
30	36 58	70 52	50	37 57	70 29	50	38 55	70 5	50	39 55	69 41	49	40 53	69 19	49	30
31	36 41	70 16	50	37 40	69 52	50	38 38	69 27	50	39 38	69 3	50	40 35	68 40	49	31
32	36 23	69 40	51	37 22	69 15	51	38 20	68 49	51	39 19	68 25	50	40 17	68 1	50	32
33	36 5	69 4	51	37 3	68 38	51	38 1	68 12	51	39 0	67 47	51	39 58	67 22	50	33
34	35 46	68 29	52	36 44	68 2	52	37 42	67 35	52	38 41	67 9	51	39 39	66 43	51	34
35	35 27	67 54	52	36 25	67 26	52	37 23	66 58	52	38 21	66 31	52	39 19	66 4	51	35
36	35 7	67 20	53	36 5	66 51	53	37 2	66 22	53	38 0	65 54	52	38 58	65 26	52	36
37	34 46	66 46	53	35 44	66 16	53	36 40	65 47	53	37 38	65 18	53	38 36	64 49	52	37
38	34 25	66 12	54	35 22	65 42	54	36 18	65 12	54	37 16	64 42	53	38 14	64 12	53	38
39	34 3	65 38	54	34 59	65 8	54	35 56	64 37	54	36 53	64 6	54	37 51	63 35	53	39
40	33 40	65 5	55	34 36	64 34	55	35 33	64 2	55	36 30	63 30	54	37 28	62 58	54	40
41	33 17	64 32	55	34 12	64 0	55	35 9	63 27	55	36 6	62 55	55	37 4	62 22	54	41
42	32 54	63 59	56	33 47	63 26	56	34 44	62 53	56	35 41	62 20	55	36 39	61 46	55	42
43	32 29	63 27	56	33 22	62 53	56	34 18	62 19	56	35 15	61 45	56	36 13	61 10	55	43
44	32 3	62 55	57	32 56	62 20	57	33 51	61 45	57	34 48	61 11	56	35 45	60 35	56	44
45	31 36	62 23	57	32 30	61 48	57	33 24	61 12	57	34 20	60 37	57	35 16	60 0	57	45

LATITUDE OF VERTEX.

Longitude from Vertex.	41°			42°			43°			44°			45°		
	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.
46	31 8	61 52	58	32 2	61 16	58	32 56	60 39	58	33 51	60 3	58	34 47	59 26	58
47	30 39	61 21	58	31 33	60 44	58	32 27	60 6	58	33 21	59 30	58	34 18	58 52	58
48	30 10	60 50	59	31 4	60 12	59	31 58	59 33	59	32 50	58 57	59	33 49	58 18	59
49	29 41	60 20	59	30 34	59 41	59	31 28	59 1	59	32 19	58 24	59	33 17	57 45	59
50	29 11	59 50	60	30 4	59 11	60	30 57	58 30	60	31 47	57 52	60	32 44	57 12	60
51	28 39	59 20	61	29 33	58 41	61	30 25	57 59	61	31 15	57 20	61	32 10	56 40	61
52	28 7	58 51	62	29 1	58 12	62	29 51	57 29	62	30 42	56 49	62	31 35	56 8	62
53	27 34	58 23	63	28 28	57 43	63	29 17	57 0	63	30 8	56 18	63	31 0	55 37	63
54	27 1	57 56	64	27 53	57 14	64	28 42	56 31	64	29 33	55 48	64	30 25	55 6	64
55	26 28	57 30	65	27 17	56 46	65	28 7	56 3	65	28 58	55 19	65	29 50	54 36	65
56	25 54	57 4	65	26 41	56 19	65	27 31	55 35	65	28 22	54 50	65	29 14	54 6	65
57	25 18	56 39	66	26 5	55 52	66	26 55	55 8	66	27 44	54 22	66	28 36	53 37	66
58	24 42	56 14	66	25 28	55 26	66	26 18	54 41	66	27 5	53 54	66	27 57	53 8	66
59	24 6	55 49	67	24 51	55 1	67	25 39	54 15	67	26 26	53 27	67	27 16	52 40	67
60	23 29	55 24	67	24 13	54 36	68	24 59	53 50	68	25 46	53 1	68	26 35	52 12	68
61	22 50	55 0	68	23 34	54 11	68	24 18	53 25	68	25 5	52 36	69	25 53	51 45	69
62	22 10	54 37	68	22 53	53 47	69	23 36	53 0	69	24 23	52 11	70	25 11	51 19	70
63	21 30	54 15	69	22 12	53 24	70	22 54	52 36	70	23 40	51 46	71	24 27	50 54	71
64	20 49	53 53	69	21 30	53 2	70	22 12	52 13	71	22 56	51 22	71	23 42	50 30	72
65	20 8	53 32	70	20 48	52 40	71	21 29	51 51	72	22 11	50 59	72	22 55	50 7	72
66	19 26	53 12	71	20 5	52 19	72	20 45	51 29	73	21 25	50 37	73	22 7	49 45	73
67	18 43	52 52	71	19 22	51 59	73	20 0	51 8	73	20 39	50 15	74	21 19	49 24	74
68	18 0	52 33	72	18 38	51 39	73	19 15	50 47	74	19 53	49 54	74	20 31	49 3	75
69	17 17	52 15	73	17 53	51 20	74	18 29	50 27	74	19 5	49 34	75	19 42	48 42	76
70	16 33	51 57	73	17 7	51 2	74	17 41	50 8	75	18 16	49 15	76	18 53	48 22	77
71	15 48	51 40	74	16 20	50 46	75	16 53	49 50	75	17 26	48 56	76	18 2	48 2	77
72	15 2	51 24	74	15 33	50 30	75	16 4	49 33	76	16 36	48 38	77	17 10	47 44	78
73	14 16	51 9	75	14 45	50 14	76	15 15	49 17	76	15 45	48 20	77	16 18	47 26	78
74	13 29	50 55	75	13 57	49 59	76	14 26	49 2	77	14 54	48 5	78	15 25	47 10	79
75	12 42	50 41	76	13 9	49 44	77	13 36	48 47	77	14 2	47 50	78	14 31	46 55	79
76	11 54	50 28	76	12 20	49 31	77	12 45	48 33	77	13 9	47 36	78	13 36	46 41	80
77	11 6	50 16	76	11 30	49 19	77	11 53	48 20	78	12 16	47 23	79	12 40	46 28	81
78	10 18	50 5	77	10 40	49 7	78	11 1	48 8	78	11 22	47 11	79	11 44	46 15	82
79	9 29	49 54	77	9 49	48 56	78	10 8	47 57	78	10 28	47 0	79	10 48	46 3	83
80	8 40	49 44	77	8 58	48 46	78	9 15	47 47	79	9 33	46 50	80	9 52	45 52	83
81	7 49	49 35	78	8 5	48 37	78	8 21	47 38	79	8 38	46 41	80	8 55	45 42	83
82	6 57	49 27	78	7 12	48 29	78	7 26	47 30	79	7 41	46 32	80	7 57	45 33	83
83	6 5	49 20	78	6 18	48 22	78	6 31	47 23	79	6 44	46 24	81	6 58	45 25	84
84	5 13	49 15	78	5 24	48 17	79	5 36	47 17	80	5 47	46 18	81	5 59	45 17	84
	4 21	49 11	78	4 30	48 12	79	4 40	47 12	80	4 50	46 13	81	5 0	45 13	84
	3 29	49 8	79	3 36	48 9	79	3 44	47 9	80	3 52	46 9	82	4 0	45 10	84
	2 37	49 6	79	2 42	48 6	79	2 48	47 6	80	2 54	46 6	82	3 0	45 7	85
	1 45	49 4	79	1 48	48 4	79	1 52	47 4	80	1 56	46 4	82	2 0	45 4	85
	0 53	49 2	79	0 54	48 2	79	0 56	47 2	80	0 58	46 2	83	1 0	45 2	85
	0 0	49 0		0 0	48 0		0 0	47 0		0 0	46 0		0 0	45 0	

Longitude from Vertex.	LATITUDE OF VERTEX.															Longitude from Vertex.
	46°			47°			48°			49°			50°			
	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	46 0	90 0	42	47 0	90 0	41	48 0	90 0	39	49 0	90 0	39	50 0	90 0	39	0
1	45 59	89 16	42	46 59	89 16	41	47 59	89 15	40	48 59	89 14	39	49 59	89 14	39	1
2	45 58	88 33	42	46 58	88 32	41	47 58	88 30	40	48 58	88 29	39	49 58	88 28	39	2
3	45 57	87 50	42	46 57	87 48	41	47 57	87 46	40	48 57	87 44	39	49 57	87 42	39	3
4	45 56	87 7	42	46 56	87 4	42	47 56	87 1	40	48 56	86 58	39	49 56	86 56	39	4
5	45 54	86 24	42	46 54	86 20	42	47 54	86 17	41	48 54	86 14	40	49 54	86 10	39	5
6	45 51	85 41	42	46 51	85 37	42	47 51	85 32	41	48 51	85 28	40	49 51	85 24	39	6
7	45 47	84 58	42	46 47	84 53	42	47 47	84 48	41	48 47	84 43	40	49 47	84 38	39	7
8	45 43	84 16	42	46 43	84 10	42	47 43	84 4	41	48 43	83 58	40	49 43	83 53	39	8
9	45 39	83 33	42	46 39	83 26	42	47 39	83 20	42	48 39	83 13	40	49 39	83 7	40	9
10	45 34	82 50	43	46 34	82 43	42	47 34	82 36	42	48 34	82 29	41	49 34	82 21	40	10
11	45 29	82 7	43	46 29	81 59	42	47 29	81 51	42	48 29	81 43	41	49 29	81 35	40	11
12	45 23	81 25	43	46 23	81 16	42	47 23	81 7	42	48 24	80 58	41	49 24	80 50	40	12
13	45 17	80 42	43	46 17	80 32	42	47 17	80 23	42	48 18	80 13	41	49 18	80 4	40	13
14	45 9	80 0	43	46 9	79 49	43	47 9	79 39	42	48 10	79 28	41	49 10	79 18	40	14
15	45 0	79 17	44	46 0	79 6	43	47 0	78 55	42	48 1	78 44	42	49 1	78 33	40	15
16	44 51	78 35	44	45 51	78 23	43	46 51	78 11	42	47 52	77 59	42	48 52	77 48	40	16
17	44 41	77 52	44	45 41	77 40	44	46 42	77 27	43	47 43	77 15	42	48 43	77 3	41	17
18	44 31	77 10	44	45 31	76 57	44	46 32	76 43	43	47 33	76 31	42	48 34	76 18	41	18
19	44 21	76 27	44	45 21	76 14	44	46 22	76 0	43	47 23	75 47	42	48 24	75 34	41	19
20	44 11	75 45	45	45 11	75 31	44	46 12	75 17	43	47 13	75 3	42	48 14	74 49	42	20
21	44 0	75 3	45	45 0	74 48	44	46 1	74 34	44	47 2	74 19	43	48 3	74 5	42	21
22	43 49	74 22	45	44 49	74 6	45	45 50	73 51	44	46 51	73 35	43	47 52	73 20	42	22
23	43 37	73 41	46	44 37	73 24	45	45 38	73 8	45	46 39	72 51	44	47 39	72 35	43	23
24	43 24	73 0	46	44 24	72 42	46	45 25	72 25	45	46 26	72 8	44	47 26	71 51	43	24
25	43 11	72 19	46	44 11	72 0	46	45 11	71 42	46	46 12	71 24	45	47 12	71 7	44	25
26	42 57	71 38	47	43 57	71 18	46	44 57	71 0	46	45 58	70 41	45	46 58	70 23	44	26
27	42 42	70 57	47	43 42	70 37	47	44 42	70 18	46	45 43	69 58	46	46 43	69 39	44	27
28	42 26	70 17	47	43 27	69 56	47	44 27	69 36	47	45 27	69 15	46	46 27	68 55	45	28
29	42 10	69 36	48	43 11	69 15	47	44 11	68 54	47	45 11	68 32	46	46 11	68 2	46	29
30	41 53	68 56	48	42 54	68 34	48	43 55	68 12	47	44 55	67 50	47	45 55	67 29	46	30
31	41 35	68 15	48	42 36	67 53	48	43 37	67 30	48	44 37	67 8	47	45 37	66 46	47	31
32	41 16	67 35	49	42 17	67 12	49	43 18	66 49	48	44 18	66 26	48	45 18	66 3	47	32
33	40 57	66 56	49	41 58	66 32	49	42 59	66 8	49	43 59	65 44	48	44 59	65 20	48	33
34	40 38	66 17	50	41 38	65 52	50	42 39	65 27	49	43 39	65 2	49	44 39	64 38	48	34
35	40 18	65 38	51	41 18	65 12	50	42 19	64 46	50	43 19	64 21	50	44 18	63 56	49	35
36	39 56	64 59	51	40 57	64 32	51	41 57	64 6	51	42 57	63 40	51	43 57	63 14	50	36
37	39 34	64 21	52	40 35	63 53	52	41 35	63 26	52	42 34	63 0	51	43 35	62 33	51	37
38	39 12	63 43	52	40 12	63 14	52	41 12	62 47	52	42 11	62 19	52	43 12	61 52	52	38
39	38 50	63 5	53	39 49	62 36	53	40 49	62 7	53	41 48	61 39	53	42 48	61 11	53	9
40	38 27	62 29	54	39 25	61 58	54	40 26	61 28	54	41 25	61 0	54	42 24	60 30	54	0
41	38 3	61 52	54	39 0	61 20	54	40 0	60 50	54	41 0	60 21	54	41 59	59 50	54	1
42	37 37	61 16	55	38 35	60 43	55	39 33	60 12	55	40 34	59 42	55	41 33	59 10	55	2
43	37 10	60 39	55	38 8	60 6	56	39 5	59 34	55	40 7	59 3	55	41 5	58 30	55	3
44	36 42	60 3	56	37 40	59 29	56	38 37	58 56	56	39 38	58 24	56	40 36	57 51	56	4
45	36 13	59 26	57	37 11	58 52	57	38 9	58 18	56	39 8	57 45	56	40 7	57 12	56	5

Longitude from Vertex.	LATITUDE OF VERTEX. 46° Lat.	Course.	Dist.	47° Lat.	Course.	Dist.	48° Lat.	Course.	Dist.	49° Lat.	Course.	Dist.	50° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	35 44	58 50	58	36 41	58 15	57	37 40	57 40	57	38 38	57 6	56	39 37	56 33	56	46
47	35 14	58 15	59	36 10	57 38	58	37 10	57 3	57	38 8	56 27	57	39 6	55 54	57	47
48	34 43	57 40	59	35 39	57 2	58	36 39	56 27	58	37 36	55 50	57	38 34	55 15	57	48
49	34 11	57 6	60	35 7	56 27	59	36 6	55 51	59	37 3	55 14	58	38 1	54 38	58	49
50	33 39	56 32	60	34 34	55 53	60	35 32	55 15	60	36 29	54 38	59	37 27	54 2	59	50
51	33 6	56 0	61	34 0	55 20	61	34 57	54 41	61	35 55	54 2	60	36 53	53 26	60	51
52	32 32	55 28	62	33 25	54 48	62	34 21	54 8	62	35 19	53 28	61	36 18	52 50	61	52
53	31 57	54 56	63	32 50	54 16	63	33 44	53 35	63	34 42	52 55	62	35 41	52 16	62	53
54	31 20	54 25	64	32 13	53 44	64	33 7	53 2	64	34 4	52 22	63	35 2	51 42	64	54
55	30 43	53 54	65	31 35	53 12	65	32 29	52 30	65	33 25	51 49	64	34 21	51 8	65	55
56	30 5	53 24	65	30 57	52 41	65	31 50	51 59	65	32 45	51 17	65	33 40	50 35	65	56
57	29 26	52 55	66	30 19	52 11	66	31 10	51 28	66	32 4	50 45	66	32 58	50 2	66	57
58	28 46	52 25	67	29 38	51 41	67	30 29	50 57	67	31 22	50 14	67	32 15	49 30	67	58
59	28 5	51 56	68	28 56	51 11	68	29 47	50 27	68	30 39	49 43	68	31 31	48 58	68	59
60	27 23	51 28	69	28 13	50 42	69	29 4	49 57	69	29 55	49 12	69	30 47	48 27	69	60
61	26 40	51 0	70	27 30	50 13	70	28 20	49 27	70	29 11	48 42	70	30 2	47 56	70	61
62	25 56	50 33	71	26 45	49 45	72	27 34	48 58	72	28 24	48 13	72	29 15	47 26	72	62
63	25 11	50 6	72	25 59	49 17	72	26 47	48 30	73	27 36	47 44	73	28 26	46 57	73	63
64	24 26	49 41	72	25 12	48 52	73	25 59	48 3	74	26 47	47 16	74	27 36	46 29	74	64
65	23 39	49 17	73	24 24	48 27	74	25 10	47 38	75	25 57	46 50	75	26 44	46 2	75	65
66	22 51	48 54	74	23 35	48 4	75	24 20	47 14	76	25 5	46 24	76	25 51	45 35	76	66
67	22 2	48 32	75	22 45	47 41	76	23 29	46 50	77	24 13	45 59	77	24 57	45 9	77	67
68	21 12	48 10	76	21 54	47 18	77	22 37	46 27	78	23 20	45 35	79	24 2	44 44	79	68
69	20 21	47 49	77	21 2	46 56	78	21 43	46 4	79	22 25	45 11	80	23 7	44 20	80	69
70	19 30	47 28	78	20 8	46 35	79	20 48	45 42	80	21 29	44 49	81	22 11	43 57	81	70
71	18 38	47 8	78	19 14	46 15	80	19 53	45 21	81	20 31	44 28	82	21 14	43 34	82	71
72	17 45	46 49	79	18 20	45 55	81	18 57	45 1	82	19 33	44 7	83	20 15	43 13	83	72
73	16 51	46 31	79	17 25	45 37	82	18 0	44 42	83	18 34	43 47	83	19 14	42 53	84	73
74	15 56	46 15	80	16 29	45 20	83	17 2	44 24	83	17 35	43 29	84	18 12	42 34	84	74
75	15 1	45 59	81	15 32	45 3	83	16 3	44 7	84	16 35	43 11	84	17 8	42 16	85	75
76	14 5	45 43	82	14 34	44 47	83	15 3	43 51	84	15 34	42 55	85	16 4	42 0	86	76
77	13 8	45 29	83	13 35	44 32	84	14 2	43 36	85	14 32	42 40	86	14 59	41 45	87	77
78	12 10	45 16	83	12 35	44 19	84	13 0	43 22	85	13 29	42 26	86	13 54	41 30	89	78
79	11 11	45 4	83	11 34	44 6	85	11 58	43 9	86	12 24	42 12	87	12 48	41 15	90	79
80	10 12	44 53	84	10 33	43 55	85	10 55	42 57	87	11 18	41 59	88	11 42	41 1	90	80
81	9 12	44 43	84	9 32	43 44	86	9 52	42 45	88	10 11	41 46	89	10 35	40 48	91	81
82	8 12	44 34	85	8 30	43 34	86	8 48	42 35	89	9 4	41 35	90	9 27	40 36	91	82
83	7 11	44 26	85	7 27	43 26	87	7 42	42 26	89	7 57	41 26	90	8 18	40 27	91	83
84	6 10	44 18	85	6 23	43 19	87	6 36	42 19	90	6 50	41 19	90	7 7	40 20	92	84
8	5 9	44 13	86	5 19	43 14	87	5 30	42 14	90	5 42	41 14	91	5 56	40 15	92	85
8	4 8	44 10	86	4 16	43 10	88	4 24	42 10	90	4 34	41 11	91	4 45	40 11	93	86
8	3 6	44 7	86	3 12	43 7	88	3 18	42 7	91	3 26	41 8	91	3 34	40 8	93	87
8	2 4	44 4	87	2 8	43 4	88	2 12	42 5	91	2 18	41 5	92	2 23	40 5	93	88
8	1 2	44 2	87	1 4	43 2	89	1 6	42 2	91	1 9	41 2	92	1 12	40 2	94	89
9	0 0	44 0		0 0	43 0		0 0	42 0		0 0	41 0		0 0	40 0		90

Longitude from Vertex.	LATITUDE OF VERTEX. 51° Lat.	Course.	Dist.	52° Lat.	Course.	Dist.	53° Lat.	Course.	Dist.	54° Lat.	Course.	Dist.	55° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	51 0	90 0	38	52 0	90 0	37	53 0	90 0	36	54 0	90 0	35	55 0	90 0	34	0
1	50 59	89 13	38	51 59	89 12	37	52 59	89 12	36	53 59	89 11	35	54 59	89 10	34	1
2	50 58	88 26	38	51 58	88 25	37	52 58	88 24	36	53 58	88 22	35	54 58	88 21	34	2
3	50 57	87 40	38	51 57	87 38	37	52 57	87 36	36	53 57	87 34	35	54 57	87 32	34	3
4	50 56	86 53	38	51 56	86 50	37	52 56	86 48	36	53 56	86 45	35	54 56	86 43	35	4
5	50 54	86 6	38	51 54	86 3	37	52 54	86 0	36	53 54	85 57	36	54 54	85 54	35	5
6	50 50	85 20	38	51 51	85 16	38	52 51	85 12	37	53 51	85 8	36	54 51	85 5	35	6
7	50 46	84 33	39	51 47	84 29	38	52 47	84 24	37	53 48	84 20	36	54 48	84 16	36	7
8	50 42	83 47	39	51 43	83 42	38	52 43	83 37	37	53 44	83 32	37	54 44	83 27	36	8
9	50 38	83 1	39	51 39	82 55	38	52 39	82 49	37	53 40	82 44	37	54 40	82 38	36	9
10	50 34	82 15	39	51 34	82 8	39	52 35	82 1	38	53 36	81 56	37	54 36	81 49	37	10
11	50 28	81 28	39	51 29	81 21	39	52 30	81 13	38	53 31	81 8	37	54 30	81 1	37	11
12	50 22	80 42	40	51 23	80 34	39	52 24	80 25	38	53 24	80 20	38	54 24	80 12	37	12
13	50 16	79 56	40	51 16	79 47	39	52 17	79 38	39	53 17	79 32	38	54 18	79 23	38	13
14	50 9	79 10	40	51 9	79 0	40	52 10	78 51	39	53 10	78 44	39	54 11	78 34	38	14
15	50 1	78 24	40	51 1	78 13	40	52 2	78 4	39	53 2	77 55	39	54 4	77 45	39	15
16	49 53	77 38	40	50 53	77 26	40	51 54	77 17	40	52 54	77 8	39	53 55	76 56	39	16
17	49 44	76 52	40	50 44	76 40	40	51 45	76 30	40	52 45	76 20	40	53 46	76 8	39	17
18	49 35	76 6	41	50 35	75 54	40	51 36	75 43	40	52 36	75 32	40	53 37	75 20	40	18
19	49 25	75 20	41	50 26	75 8	41	51 26	74 56	41	52 27	74 44	40	53 28	74 32	40	19
20	49 14	74 35	41	50 16	74 22	41	51 16	74 10	41	52 18	73 56	41	53 19	73 44	40	20
21	49 3	73 50	42	50 5	73 36	42	51 5	73 23	41	52 6	73 8	41	53 7	72 56	41	21
22	48 51	73 4	42	49 53	72 50	42	50 54	72 36	42	51 54	72 21	42	52 55	72 8	41	22
23	48 39	72 19	42	49 41	72 4	42	50 42	71 49	42	51 42	71 34	42	52 43	71 20	41	23
24	48 26	71 34	43	49 28	71 18	42	50 29	71 3	42	51 30	70 48	42	52 31	70 32	41	24
25	48 12	70 49	43	49 14	70 33	43	50 16	70 17	43	51 17	70 2	43	52 19	69 44	42	25
26	47 58	70 4	44	49 0	69 48	44	50 1	69 32	43	51 3	69 15	43	52 4	68 57	42	26
27	47 43	69 15	44	48 45	69 3	44	49 46	68 46	43	50 49	68 28	43	51 49	68 10	42	27
28	47 28	68 35	44	48 30	68 18	44	49 31	68 0	44	50 34	67 41	44	51 34	67 23	43	28
29	47 13	67 51	45	48 15	67 33	45	49 16	67 14	44	50 18	66 55	44	51 19	66 36	43	29
30	46 56	67 7	45	47 58	66 49	45	49 0	66 29	44	50 1	66 8	44	51 3	65 49	43	30
31	46 38	66 24	46	47 40	66 4	46	48 42	65 44	45	49 43	65 22	45	50 44	65 3	44	31
32	46 19	65 41	46	47 21	65 20	46	48 23	64 59	45	49 24	64 36	45	50 25	64 17	44	32
33	46 0	64 58	47	47 2	64 36	46	48 3	64 14	46	49 5	63 51	45	50 5	63 31	44	33
34	45 40	64 15	47	46 42	63 52	47	47 43	63 29	46	48 45	63 6	46	49 45	62 45	45	34
35	45 20	63 32	48	46 21	63 8	47	47 22	62 44	46	48 24	62 21	46	49 25	61 59	45	35
36	44 58	62 49	49	46 0	62 24	47	47 1	62 0	47	48 2	61 36	46	49 3	61 13	45	36
37	44 35	62 7	50	45 38	61 41	48	46 39	61 16	47	47 41	60 52	47	48 41	60 28	46	37
38	44 12	61 25	51	45 16	60 58	49	46 17	60 33	48	47 18	60 8	47	48 19	59 43	46	38
39	43 49	60 43	52	44 53	60 16	50	45 55	59 50	49	46 55	59 24	48	47 57	58 58	47	
40	43 25	60 2	53	44 28	59 34	51	45 30	59 7	50	46 32	58 40	49	47 34	58 14	47	
41	42 59	59 21	53	44 1	58 52	52	45 3	58 24	51	46 5	57 57	50	47 7	57 29	48	
42	42 32	58 41	54	43 24	58 10	52	44 36	57 42	52	45 37	57 14	51	46 40	56 45	49	
43	42 5	58 0	55	43 6	57 29	53	44 8	57 0	53	45 9	56 31	52	46 13	56 2	50	
44	41 37	57 20	55	42 37	56 49	54	43 39	56 18	54	44 41	55 48	52	45 45	55 19	51	
45	41 9	56 40	56	42 8	56 8	55	43 10	55 37	54	44 13	55 6	53	45 17	54 36	52	

Longitude from Vertex.	LATITUDE OF VERTEX. 51° Lat.	Course.	Dist.	52° Lat.	Course.	Dist.	53° Lat.	Course.	Dist.	54° Lat.	Course.	Dist.	55° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	40 38	56 0	55	41 39	55 28	55	42 41	54 56	54	43 44	54 25	54	44 48	53 54	53	46
47	40 7	55 20	56	41 8	54 48	55	42 10	54 16	55	43 13	53 43	55	44 17	53 12	54	47
48	39 35	54 40	57	40 36	54 7	56	41 37	53 35	56	42 40	53 2	56	43 44	52 30	55	48
49	39 1	54 2	58	40 2	53 28	57	41 2	52 55	57	42 5	52 22	57	43 9	51 49	57	49
50	38 26	53 26	59	39 26	52 50	58	40 27	52 16	58	41 29	51 42	58	42 33	51 8	58	50
51	37 51	52 50	60	38 50	52 13	59	39 51	51 37	59	40 53	51 3	59	41 56	50 28	59	51
52	37 15	52 14	61	38 13	51 36	60	39 14	50 59	60	40 16	50 24	60	41 19	49 48	60	52
53	36 37	51 38	62	37 35	50 59	61	38 36	50 21	61	39 38	49 45	60	40 40	49 8	60	53
54	35 58	51 3	63	36 57	50 23	62	37 58	49 44	62	38 59	49 6	61	40 0	48 29	61	54
55	35 18	50 28	64	36 18	49 47	63	37 18	49 8	63	38 18	48 29	62	39 19	47 51	62	55
56	34 37	49 53	65	35 37	49 12	64	36 36	48 32	64	37 36	47 53	64	38 38	47 14	64	56
57	33 55	49 19	66	34 54	48 38	66	35 53	47 57	66	36 52	47 17	66	37 54	46 37	66	57
58	33 11	48 46	67	34 9	48 4	68	35 8	47 22	68	36 7	46 41	68	37 9	46 1	68	58
59	32 26	48 14	68	33 23	47 31	69	34 21	46 48	70	35 20	46 6	70	36 21	45 25	70	59
60	31 40	47 43	69	32 35	46 59	70	33 32	46 15	71	34 31	45 32	71	35 32	44 49	71	60
61	30 53	47 13	70	31 46	46 27	71	32 42	45 42	72	33 41	44 58	72	34 42	44 14	72	61
62	30 5	46 43	72	30 56	45 56	73	31 51	45 10	73	32 50	44 25	73	33 50	43 40	73	62
63	29 15	46 13	73	30 5	45 25	74	30 59	44 38	74	31 58	43 52	74	32 57	43 7	74	63
64	28 24	45 43	74	29 14	44 55	75	30 7	44 7	75	31 4	43 21	75	32 2	42 35	76	64
65	27 32	45 13	75	28 22	44 26	76	29 14	43 37	77	30 9	42 50	77	31 6	42 4	78	65
66	26 39	44 44	76	27 28	43 57	77	28 20	43 8	78	29 12	42 20	78	30 9	41 33	79	66
67	25 45	44 17	78	26 33	43 28	79	27 24	42 40	79	28 14	41 51	80	29 10	41 3	81	67
68	24 49	43 51	79	25 36	43 2	80	26 27	42 13	81	27 15	41 23	81	28 9	40 34	82	68
69	23 52	43 27	80	24 38	42 37	81	25 27	41 47	82	26 15	40 56	83	27 6	40 6	83	69
70	22 54	43 5	81	23 39	42 14	82	24 25	41 22	83	25 13	40 30	84	26 2	39 39	84	70
71	21 55	42 44	82	22 38	41 51	83	23 22	40 58	84	24 9	40 5	86	24 57	39 13	86	71
72	20 54	42 23	83	21 36	41 29	84	22 17	40 35	86	23 3	39 41	88	23 50	38 49	88	72
73	19 52	42 2	84	20 32	41 7	85	21 11	40 13	87	21 56	39 18	89	22 41	38 26	90	73
74	18 48	41 41	85	19 26	40 46	87	20 4	39 52	88	20 47	38 57	90	21 30	38 4	93	74
75	17 42	41 21	86	18 18	40 26	89	18 56	39 31	89	19 36	38 36	91	20 17	37 43	94	75
76	16 36	41 4	88	17 10	40 7	90	17 46	39 11	90	18 23	38 16	93	19 2	37 23	95	76
77	15 30	40 48	89	16 1	39 50	91	16 35	38 53	91	17 10	37 58	94	17 47	37 4	95	77
78	14 23	40 32	90	14 52	39 33	91	15 24	38 37	93	15 56	37 40	95	16 31	36 46	96	78
79	13 15	40 17	90	13 43	39 18	92	14 12	38 22	93	14 42	37 23	95	15 15	36 29	96	79
80	12 7	40 3	91	12 33	39 5	93	13 0	38 7	94	13 28	37 9	96	13 58	36 13	97	80
81	10 58	39 50	92	11 22	38 51	93	11 47	37 53	95	12 12	36 55	96	12 39	35 58	100	81
82	9 48	39 38	92	10 9	38 39	94	10 32	37 40	95	10 54	36 42	97	11 18	35 45	101	82
83	8 36	39 29	93	8 55	38 30	94	9 15	37 30	96	9 35	36 31	98	9 55	35 34	103	83
84	7 24	39 21	93	7 40	38 22	95	7 57	37 22	96	8 14	36 23	99	8 31	35 25	104	84
8	6 10	39 15	94	6 24	38 16	95	6 38	37 16	97	6 52	36 17	100	7 6	35 18	104	85
8	4 56	39 12	94	5 8	38 12	95	5 19	37 12	98	5 30	36 13	101	5 41	35 13	104	86
8	3 42	39 9	95	3 51	38 9	95	4 0	37 9	99	4 8	36 9	101	4 16	35 9	104	87
8	2 28	39 6	95	2 34	38 6	96	2 40	37 6	99	2 46	36 6	102	2 51	35 6	104	88
8	1 14	39 3	96	1 17	38 3	96	1 20	37 3	99	1 23	36 3	102	1 26	35 3	104	89
9	0 0	39 0		0 0	38 0		0 0	37 0		0 0	36 0		0 0	35 0		90

Longitude from Vertex.	LATITUDE OF VERTEX. 56° Lat.	Course.	Dist.	57° Lat.	Course.	Dist.	58° Lat.	Course.	Dist.	59° Lat.	Course.	Dist.	60° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	56 0	90 0	33	57 0	90 0	33	58 0	90 0	31	59 0	90 0	31	60 0	90 0	30	0
1	55 59	89 10	33	56 59	89 9	33	57 59	89 9	31	58 59	89 8	31	59 59	89 8	30	1
2	55 58	88 20	33	56 58	88 19	33	57 58	88 18	32	58 58	88 17	31	59 58	88 16	31	2
3	55 57	87 30	34	56 57	87 28	33	57 57	87 27	32	58 57	87 25	31	59 57	87 24	31	3
4	55 56	86 40	34	56 56	86 38	33	57 56	86 36	32	58 56	86 34	31	59 56	86 32	31	4
5	55 54	85 51	34	56 54	85 48	33	57 54	85 45	32	58 54	85 42	31	59 54	85 40	31	5
6	55 51	85 1	34	56 51	84 58	33	57 52	84 54	32	58 51	84 51	31	59 51	84 48	31	6
7	55 48	84 12	34	56 48	84 8	33	57 49	84 4	33	58 48	84 0	32	59 48	83 56	31	7
8	55 44	83 22	34	56 44	83 18	33	57 46	83 13	33	58 45	83 9	32	59 45	83 5	32	8
9	55 40	82 33	34	56 40	82 28	33	57 42	82 23	33	58 41	82 18	32	59 41	82 13	32	9
10	55 36	81 43	35	56 36	81 38	34	57 37	81 32	33	58 37	81 27	32	59 37	81 22	32	10
11	55 30	80 54	35	56 30	80 48	34	57 31	80 42	33	58 31	80 36	33	59 32	80 30	32	11
12	55 24	80 5	35	56 24	79 58	34	57 25	79 51	33	58 25	79 44	33	59 27	79 38	32	12
13	55 18	79 15	36	56 18	79 8	34	57 19	79 1	33	58 19	78 53	33	59 21	78 46	32	13
14	55 11	78 26	36	56 12	78 18	34	57 13	78 10	33	58 13	78 2	33	59 15	77 54	33	14
15	55 4	77 37	36	56 5	77 28	34	57 6	77 20	34	58 7	77 11	33	59 8	77 3	33	15
16	54 56	76 48	37	55 57	76 38	35	56 58	76 29	34	57 59	76 20	33	59 0	76 11	33	16
17	54 48	75 59	37	55 49	75 49	35	56 50	75 39	34	57 51	75 29	33	58 52	75 20	33	17
18	54 40	75 10	37	55 41	74 59	35	56 42	74 49	34	57 43	74 38	34	58 43	74 29	33	18
19	54 31	74 21	38	55 32	74 10	36	56 33	73 59	35	57 34	73 48	34	58 35	73 38	33	19
20	54 22	73 32	38	55 23	73 20	36	56 24	73 9	35	57 24	72 57	34	58 26	72 46	34	20
21	54 10	72 43	39	55 11	72 31	37	56 16	72 19	35	57 14	72 7	35	58 15	71 55	34	21
22	53 58	71 55	39	54 59	71 41	37	56 3	71 29	36	57 3	71 16	35	58 6	71 4	34	22
23	53 46	71 6	39	54 47	70 52	37	55 51	70 39	36	56 51	70 26	35	57 55	70 13	35	23
24	53 34	70 18	40	54 35	70 3	38	55 38	69 49	37	56 39	69 36	36	57 43	69 22	35	24
25	53 21	69 30	40	54 23	69 15	38	55 25	69 0	37	56 27	68 46	36	57 30	68 32	36	25
26	53 6	68 42	41	54 9	68 26	39	55 11	68 11	37	56 14	67 56	37	57 16	67 42	36	26
27	52 51	67 54	41	53 54	67 38	39	54 57	67 22	38	56 1	67 7	37	57 2	66 52	37	27
28	52 36	67 6	41	53 39	66 50	39	54 42	66 33	38	55 47	66 17	37	56 48	66 1	37	28
29	52 21	66 18	42	53 24	66 1	40	54 27	65 44	39	55 32	65 27	38	56 33	65 11	37	29
30	52 6	65 31	42	53 9	65 13	41	54 12	64 55	39	55 15	64 37	38	56 18	64 20	38	30
31	51 47	64 44	43	52 50	64 25	42	53 54	64 7	39	54 57	63 48	39	56 1	63 30	38	31
32	51 29	63 57	43	52 32	63 37	43	53 36	63 19	40	54 39	62 59	39	55 44	62 40	39	32
33	51 11	63 11	44	52 13	62 50	43	53 18	62 31	41	54 21	62 10	39	55 26	61 51	39	33
34	50 52	62 24	44	51 54	62 2	44	52 59	61 43	42	54 3	61 21	40	55 8	61 2	39	34
35	50 32	61 37	45	51 35	61 15	44	52 40	60 55	43	53 45	60 33	41	54 50	60 13	40	35
36	50 11	60 50	45	51 16	60 28	45	52 19	60 6	43	53 24	59 45	43	54 32	59 24	41	36
37	49 49	60 4	46	50 55	59 40	45	51 58	59 18	44	53 4	58 57	44	54 13	58 36	43	37
38	49 27	59 18	46	50 33	58 53	46	51 36	58 30	44	52 43	58 9	44	53 52	57 48	44	38
39	49 5	58 32	47	50 10	58 6	46	51 14	57 43	45	52 21	57 21	45	53 29	57 0	45	39
40	48 40	57 46	47	49 46	57 20	47	50 52	56 56	46	51 58	56 34	45	53 4	56 12	45	40
41	48 13	57 4	48	49 20	56 35	47	50 25	56 10	47	51 31	55 47	46	52 37	55 24	46	41
42	47 46	56 19	49	48 53	55 50	48	49 58	55 24	48	51 4	55 0	47	52 10	54 36	47	42
43	47 19	55 35	50	48 26	55 5	49	49 31	54 38	49	50 36	54 13	48	51 42	53 48	48	43
44	46 51	54 50	51	47 58	54 21	50	49 3	53 53	50	50 8	53 26	49	51 14	53 0	49	44
45	46 23	54 6	52	47 30	53 37	51	48 35	53 8	51	49 40	52 40	50	50 46	52 13	49	45

Longitude from Vertex.	LATITUDE OF VERTEX. 56° Lat.	Course.	Dist.	57° Lat.	Course.	Dist.	58° Lat.	Course.	Dist.	59° Lat.	Course.	Dist.	60° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	45 53	53 24	53	46 58	52 55	52	48 4	52 25	52	49 10	51 56	51	50 17	51 28	50	46
47	45 22	52 41	54	46 27	52 11	53	47 33	51 41	53	48 39	51 11	52	49 46	50 42	51	47
48	44 50	51 59	55	45 55	51 28	54	47 1	50 57	53	48 7	50 27	52	49 14	49 57	51	48
49	44 15	51 17	56	45 20	50 45	55	46 26	50 13	54	47 33	49 43	53	48 40	49 12	52	49
50	43 38	50 35	57	44 43	50 2	56	45 49	49 29	55	46 56	48 59	54	48 4	48 27	53	50
51	43 0	49 53	58	44 5	49 20	58	45 11	48 46	57	46 18	48 15	56	47 27	47 43	55	51
52	42 21	49 12	60	43 26	48 38	59	44 32	48 4	59	45 39	47 31	58	46 49	46 59	57	52
53	41 42	48 32	60	42 47	47 57	60	43 52	47 22	60	45 0	46 48	60	46 10	46 15	59	53
54	41 2	47 53	61	42 7	47 17	61	43 12	46 41	61	44 20	46 6	61	45 30	45 32	61	54
55	40 21	47 14	62	41 26	46 37	62	42 30	46 1	62	43 39	45 25	62	44 49	44 49	62	55
56	39 39	46 35	64	40 43	45 58	64	41 47	45 21	63	42 57	44 44	63	44 6	44 7	63	56
57	38 55	45 57	65	39 59	45 19	65	41 3	44 41	65	42 12	44 3	64	43 21	43 26	64	57
58	38 10	45 20	67	39 13	44 41	67	40 17	44 2	67	41 25	43 23	66	42 34	42 45	66	58
59	37 23	44 43	70	38 26	44 3	69	39 30	43 23	69	40 37	42 44	68	41 45	42 5	67	59
60	36 34	44 7	72	37 37	43 26	71	38 42	42 45	71	39 47	42 5	70	40 54	41 25	69	60
61	35 44	43 31	73	36 46	42 49	73	37 52	42 8	73	38 55	41 27	71	40 1	40 46	71	61
62	34 52	42 56	74	35 54	42 13	75	36 58	41 31	75	38 1	40 49	73	39 6	40 8	73	62
63	33 58	42 22	75	35 0	41 38	76	36 2	40 55	77	37 6	40 12	75	38 10	39 30	75	63
64	33 2	41 50	76	34 3	41 5	77	35 4	40 20	78	36 8	39 36	78	37 12	38 53	78	64
65	32 4	41 18	78	33 4	40 32	79	34 4	39 46	79	35 8	39 1	80	36 12	38 17	80	65
66	31 4	40 46	79	32 4	39 59	80	33 3	39 13	81	34 6	38 27	82	35 10	37 42	83	66
67	30 3	40 16	81	31 2	39 28	82	32 0	38 41	83	33 3	37 54	84	34 6	37 8	85	67
68	29 1	39 46	82	29 58	38 58	83	30 55	38 10	85	31 57	37 22	86	32 59	36 35	88	68
69	27 58	39 17	84	28 53	38 28	85	29 49	37 39	87	30 50	36 51	89	31 50	36 3	91	69
70	26 53	38 49	86	27 46	37 59	88	28 41	37 9	90	29 39	36 20	91	30 39	35 32	92	70
71	25 46	38 22	88	26 38	37 31	90	27 31	36 41	92	28 26	35 51	92	29 26	35 2	93	71
72	24 37	37 56	90	25 28	37 5	92	26 19	36 14	93	27 12	35 23	94	28 10	34 33	94	72
73	23 26	37 32	92	24 15	36 40	94	25 5	35 48	95	25 56	34 56	96	26 52	34 5	96	73
74	22 13	37 9	94	23 0	36 16	96	23 48	35 23	97	24 38	34 31	98	25 32	33 39	97	74
75	20 59	36 48	96	21 43	35 54	98	22 29	35 0	99	23 18	34 7	100	24 9	33 14	100	75
76	19 43	36 28	97	20 25	35 33	99	21 8	34 38	100	21 56	33 44	102	22 44	32 50	102	76
77	18 26	36 9	98	19 6	35 13	100	19 46	34 17	101	20 32	33 22	103	21 17	32 28	105	77
78	17 7	35 51	99	17 44	34 54	101	18 22	33 57	102	19 6	33 2	104	19 48	32 7	108	78
79	15 47	35 33	100	16 20	34 36	102	16 57	33 39	103	17 37	32 43	105	18 17	31 47	111	79
80	14 25	35 16	101	14 55	34 19	103	15 30	33 22	104	16 6	32 25	106	16 44	31 28	112	80
81	13 2	35 0	101	13 29	34 3	103	14 2	33 6	105	14 34	32 8	107	15 10	31 10	113	81
82	11 38	34 47	102	12 2	33 49	104	12 32	32 51	106	13 1	31 52	108	13 34	30 54	114	82
83	10 13	34 36	103	10 35	33 37	105	11 1	32 38	107	11 27	31 39	109	11 56	30 41	115	83
84	8 47	34 26	103	9 7	33 27	106	9 29	32 28	108	9 52	31 29	110	10 17	30 31	116	84
8	7 21	34 19	104	7 38	33 20	107	7 56	32 21	109	8 15	31 22	111	8 35	30 23	117	85
8	5 54	34 14	105	6 8	33 15	108	6 22	32 15	110	6 37	31 16	112	6 53	30 17	118	86
8	4 27	34 10	105	4 37	33 10	108	4 47	32 10	111	4 58	31 11	113	5 10	30 12	119	87
8	2 59	34 6	106	3 5	33 6	109	3 12	32 6	112	3 19	31 7	114	3 27	30 7	120	88
8	1 30	34 3	106	1 33	33 3	109	1 36	32 3	112	1 40	31 3	115	1 44	30 3	121	89
9	0 0	34 0		0 0	33 0		0 0	32 0		0 0	31 0		0 0	30 0		90

Longitude from Vertex.	LATITUDE OF VERTEX.															Longitude from Vertex.
	61°			62°			63°			64°			65°			
	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	61 0	90 0	29	62 0	90 0	28	63 0	90 0	27	64 0	90 0	26	65 0	90 0	25	0
1	60 59	89 7	29	61 59	89 6	28	62 59	89 6	27	63 59	89 5	26	64 59	89 5	25	1
2	60 58	88 15	29	61 58	88 13	28	62 58	88 12	27	63 58	88 11	26	64 58	88 10	25	2
3	60 57	87 22	29	61 57	87 20	28	62 57	87 19	27	63 57	87 18	26	64 57	87 16	25	3
4	60 56	86 30	30	61 56	86 28	28	62 56	86 25	27	63 56	86 24	26	64 56	86 22	25	4
5	60 54	85 37	30	61 55	85 35	28	62 55	85 32	27	63 54	85 30	26	64 55	85 28	26	5
6	60 51	84 45	30	61 52	84 42	28	62 52	84 39	27	63 52	84 36	26	64 52	84 33	26	6
7	60 48	83 52	30	61 49	83 49	28	62 49	83 45	27	63 49	83 42	27	64 49	83 39	26	7
8	60 45	83 0	30	61 46	82 57	29	62 46	82 52	27	63 46	82 49	27	64 46	82 45	26	8
9	60 42	82 7	30	61 42	82 4	29	62 43	81 59	27	63 43	81 55	27	64 43	81 51	26	9
10	60 38	81 15	31	61 38	81 11	29	62 39	81 5	28	63 39	81 1	27	64 40	80 57	26	10
11	60 33	80 23	31	61 33	80 18	30	62 34	80 12	28	63 34	80 8	27	64 35	80 3	27	11
12	60 28	79 31	31	61 28	79 25	30	62 29	79 19	28	63 29	79 14	27	64 30	79 8	27	12
13	60 22	78 39	32	61 23	78 32	30	62 24	78 26	28	63 24	78 20	27	64 25	78 14	27	13
14	60 16	77 47	32	61 17	77 40	31	62 18	77 33	29	63 19	77 26	27	64 20	77 20	27	14
15	60 10	76 55	32	61 11	76 47	31	62 12	76 40	29	63 13	76 33	27	64 14	76 16	27	15
16	60 3	76 3	32	61 4	75 55	31	62 5	75 47	29	63 6	75 39	28	64 7	75 32	27	16
17	59 55	75 11	33	60 56	75 2	31	61 57	74 54	30	62 59	74 46	28	64 0	74 38	27	17
18	59 46	74 19	33	60 48	74 10	32	61 49	74 1	30	62 51	73 52	28	63 53	73 44	27	18
19	59 37	73 27	33	60 39	73 18	32	61 41	73 8	31	62 43	72 59	29	63 45	72 50	28	19
20	59 28	72 36	33	60 30	72 26	32	61 32	72 15	31	62 34	72 6	29	63 37	71 57	28	20
21	59 18	71 44	33	60 20	71 34	33	61 22	71 22	32	62 25	71 13	30	63 28	71 4	28	21
22	59 7	70 53	34	60 10	70 42	33	61 12	70 30	32	62 16	70 20	31	63 18	70 10	29	22
23	58 56	70 1	34	59 59	69 50	33	61 2	69 37	33	62 6	69 27	31	63 8	69 17	29	23
24	58 45	69 10	34	59 48	68 59	34	60 51	68 45	33	61 55	68 34	32	62 58	68 23	30	24
25	58 33	68 19	35	59 36	68 7	34	60 40	67 53	34	61 43	67 41	33	62 47	67 29	31	25
26	58 20	67 28	35	59 23	67 16	35	60 27	67 1	34	61 20	66 49	33	62 35	66 36	32	26
27	58 6	66 37	36	59 9	66 24	35	60 14	66 9	34	61 17	65 56	34	62 22	65 43	33	27
28	57 52	65 46	37	58 55	65 32	36	60 0	65 17	35	61 4	65 3	34	62 9	64 50	34	28
29	57 37	64 55	37	58 41	64 40	37	59 46	64 25	36	60 51	64 10	35	61 56	63 57	35	29
30	57 22	64 4	38	58 27	63 49	37	59 32	63 33	37	60 37	63 18	36	61 42	63 3	36	30
31	57 6	63 14	38	58 12	62 57	38	59 17	62 41	37	60 21	62 26	37	61 26	62 10	37	31
32	56 49	62 24	39	57 56	62 6	38	59 1	61 49	38	60 5	61 34	37	61 10	61 17	37	32
33	56 32	61 34	39	57 39	61 16	39	58 44	60 59	38	59 48	60 42	38	60 54	60 25	38	33
34	56 14	60 45	39	57 21	60 26	39	58 26	60 8	39	59 31	59 50	38	60 38	59 33	38	34
35	55 56	59 55	40	57 2	59 36	40	58 8	59 17	39	59 14	58 58	39	60 21	58 41	39	35
36	55 37	59 6	41	56 43	58 46	40	57 49	58 26	40	58 56	58 7	39	60 3	57 49	39	36
37	55 17	58 16	42	56 23	57 56	41	57 29	57 35	40	58 37	57 16	40	59 44	56 58	40	37
38	54 56	57 27	43	56 2	57 6	42	57 8	56 45	41	58 16	56 25	40	59 24	56 6	40	38
39	54 34	56 37	44	55 40	55 16	43	56 47	55 54	42	57 54	55 34	41	59 2	55 14	41	9
40	54 11	55 48	44	55 18	55 26	43	56 25	55 3	42	57 32	54 43	41	58 40	54 22	41	0
41	53 46	54 59	45	54 53	54 36	44	56 2	54 13	43	57 9	53 53	42	58 17	53 31	42	1
42	53 20	54 11	46	54 27	53 47	45	55 37	53 24	44	56 45	53 2	43	57 53	52 40	42	2
43	52 53	53 23	47	54 1	52 58	46	55 11	52 35	45	56 20	52 12	44	57 28	51 50	43	3
44	52 25	52 35	48	53 34	52 10	47	54 44	51 46	46	55 53	51 21	45	57 2	50 59	44	4
45	51 56	51 47	48	53 5	51 22	47	54 16	50 57	46	55 25	50 31	45	56 36	50 9	44	5

Longitude from Vertex.	LATITUDE OF VERTEX. 61° Lat.	Course.	Dist.	62° Lat.	Course.	Dist.	63° Lat.	Course.	Dist.	64° Lat.	Course.	Dist.	65° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	51 27	51 0	49	52 35	50 34	48	53 46	50 8	47	54 56	49 41	46	56 9	49 19	45	46
47	50 57	50 13	50	52 5	49 47	49	53 15	49 19	48	54 26	48 52	47	55 40	48 29	46	47
48	50 24	49 27	51	51 33	49 0	50	52 43	48 31	49	53 55	48 3	48	55 9	47 39	47	48
49	49 49	48 41	51	50 59	48 13	51	52 10	47 43	50	53 22	47 14	49	54 36	46 50	47	49
50	49 13	47 56	52	50 23	47 26	51	51 35	46 56	51	52 48	46 26	50	54 2	46 1	48	50
51	48 36	47 11	53	49 46	46 40	52	50 59	46 10	52	52 13	45 39	51	53 27	45 12	50	51
52	47 58	46 26	55	49 9	45 55	54	50 22	45 24	53	51 36	45 53	52	52 50	44 24	52	52
53	47 19	45 42	58	48 31	45 10	57	49 44	44 38	56	50 58	44 7	55	52 12	43 37	55	53
54	46 40	44 58	60	47 52	44 25	59	49 5	43 52	58	50 19	43 21	57	51 33	42 50	57	54
55	46 0	44 14	62	47 12	43 40	61	48 25	43 7	60	49 39	42 35	58	50 53	42 4	58	55
56	45 18	43 31	63	46 30	42 56	62	47 43	42 22	61	48 57	41 50	59	50 11	41 18	59	56
57	44 33	42 49	64	45 45	42 13	64	46 58	41 38	63	48 12	41 5	61	49 27	40 32	61	57
58	43 45	42 8	66	44 57	41 31	65	46 10	40 55	64	47 24	40 20	63	48 40	39 46	63	58
59	42 55	41 27	67	44 7	40 49	66	45 20	40 12	66	46 34	39 36	65	47 51	39 1	65	59
60	42 3	40 46	68	43 14	40 8	67	44 27	39 30	67	45 42	38 43	67	47 0	38 17	67	60
61	41 9	40 6	70	42 20	39 27	70	43 33	38 49	70	44 48	38 11	70	46 6	37 34	70	61
62	40 14	39 27	73	41 24	38 47	73	42 37	38 8	73	43 52	37 29	73	45 10	36 51	73	62
63	39 17	38 49	74	40 27	38 8	74	41 40	37 27	74	42 55	36 48	74	44 12	36 9	74	63
64	38 19	38 11	77	39 29	37 29	77	40 42	36 48	76	41 56	36 8	76	43 12	35 28	75	64
65	37 19	37 34	80	38 29	36 51	79	39 42	36 9	78	40 56	35 28	78	42 11	34 47	78	65
66	36 17	36 57	82	37 27	36 13	82	38 39	35 31	78	39 53	34 49	83	41 7	34 7	83	66
67	35 12	36 22	83	36 22	35 37	83	37 33	34 53	84	38 46	34 10	84	40 0	33 28	85	67
68	34 5	35 48	85	35 14	35 2	85	36 23	34 17	86	37 35	33 33	86	38 49	32 50	87	68
69	32 55	35 15	88	34 2	34 28	88	35 10	33 42	91	36 21	32 57	91	37 34	32 13	92	69
70	31 42	34 44	91	32 47	33 56	91	33 54	33 9	94	35 3	32 22	94	36 15	31 36	94	70
71	30 26	34 13	95	31 30	33 24	95	32 36	32 36	97	33 43	31 48	97	34 54	31 0	97	71
72	29 8	33 43	97	30 10	32 53	97	31 15	32 4	98	32 20	31 15	99	33 30	30 26	100	72
73	27 48	33 14	98	28 48	32 24	100	29 52	31 34	101	30 54	30 44	102	32 3	29 54	103	73
74	26 26	32 47	100	27 24	31 56	102	28 26	31 5	103	29 27	30 14	105	30 34	29 23	107	74
75	25 2	32 22	102	25 58	31 30	105	26 57	30 38	106	27 58	29 46	108	29 2	28 54	109	75
76	23 36	31 57	105	24 29	31 4	110	25 25	30 11	111	26 25	29 18	112	27 26	28 26	113	76
77	22 7	31 34	108	22 57	30 40	112	23 50	29 46	115	24 48	28 53	116	25 46	28 0	117	77
78	20 35	31 12	112	21 23	30 17	115	22 13	29 23	118	23 8	28 29	120	24 3	27 35	121	78
79	19 1	30 51	113	19 46	29 55	117	20 33	29 1	121	21 24	28 6	122	22 16	27 11	124	79
80	17 24	30 31	115	18 6	29 34	119	18 50	28 40	123	19 36	27 44	124	20 25	26 49	126	80
81	15 46	30 12	116	16 24	29 14	121	17 5	28 15	125	17 46	27 19	126	18 31	26 22	129	81
82	14 6	29 56	117	14 41	28 59	123	15 18	28 1	126	15 54	27 4	129	16 35	26 6	131	82
83	12 25	29 43	119	12 56	28 45	124	13 29	27 47	127	14 1	26 49	132	14 37	25 51	134	83
84	10 42	29 32	121	11 9	28 33	125	11 38	27 34	128	12 6	26 36	134	12 37	25 38	137	84
8	8 57	29 24	123	9 20	28 25	126	9 44	27 26	130	10 9	26 27	136	10 35	25 28	138	85
8	7 11	29 17	124	7 30	28 17	128	7 49	27 18	131	8 11	26 19	138	8 32	25 20	139	86
8	5 24	29 12	125	5 39	28 12	130	5 53	27 12	133	6 11	26 12	138	6 27	25 13	140	87
8	3 37	29 7	126	3 47	28 8	131	3 56	27 8	134	4 9	26 8	139	4 20	25 8	142	88
8	1 49	29 3	126	1 54	28 4	131	1 58	27 4	135	2 5	26 4	139	2 11	25 4	143	89
9	0 0	29 0		0 0	28 0		0 0	27 0		0 0	26 0		0 0	25 0		90

Longitude from Vertex.	LATITUDE OF VERTEX.															Longitude from Vertex.
	66°			67°			68°			69°			70°			
	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	66 0	90 0	24	67 0	90 0	23	68 0	90 0	22	69 0	90 0	21	70 0	90 0	21	0
1	65 59	89 5	24	66 59	89 4	23	68 0	89 4	22	69 0	89 3	21	70 0	89 3	21	1
2	65 58	88 10	24	66 58	88 8	23	67 59	88 8	22	68 59	88 7	21	69 59	88 6	21	2
3	65 57	87 15	24	66 57	87 13	23	67 58	87 12	22	68 58	87 11	21	69 58	87 10	21	3
4	65 56	86 21	24	66 58	86 18	23	67 57	86 17	22	68 57	86 15	21	69 57	86 14	21	4
5	65 55	85 26	24	66 55	85 23	23	67 56	85 21	22	68 56	85 19	21	69 56	85 18	21	5
6	65 53	84 31	24	66 53	84 28	23	67 54	84 26	22	68 54	84 23	21	69 54	84 21	21	6
7	65 51	83 36	24	66 41	83 33	23	67 52	83 30	23	68 52	83 27	22	69 52	83 25	21	7
8	65 48	82 41	24	66 48	82 38	24	67 49	82 35	23	68 49	82 31	22	69 50	82 28	21	8
9	65 45	81 47	24	66 45	81 43	24	67 46	81 39	23	68 46	81 35	22	69 47	81 32	21	9
10	65 41	80 52	24	66 41	80 48	24	67 42	80 44	23	68 42	80 40	22	69 43	80 36	21	10
11	65 37	79 58	25	66 37	79 53	24	67 38	79 48	23	68 38	79 44	22	69 39	79 40	21	11
12	65 32	79 3	25	66 33	78 58	24	67 34	78 53	23	68 34	78 48	22	69 35	78 44	22	12
13	65 27	78 9	25	66 29	78 3	24	67 30	77 57	23	68 30	77 53	22	69 31	77 48	22	13
14	65 22	77 14	25	66 24	77 8	24	67 25	77 2	24	68 26	76 57	22	69 27	76 52	22	14
15	65 16	76 20	26	66 18	76 14	24	67 19	76 7	24	68 20	76 2	23	69 21	75 56	22	15
16	65 10	75 25	26	66 11	75 19	25	67 13	75 12	24	68 14	75 6	23	69 15	75 0	22	16
17	65 3	74 31	26	66 4	74 24	25	67 7	74 16	24	68 8	74 10	23	69 9	74 4	22	17
18	64 56	73 36	26	65 57	73 29	25	67 0	73 21	24	68 2	73 15	23	69 3	73 8	22	18
19	64 48	72 42	27	65 49	72 34	25	66 52	72 26	24	67 55	72 19	24	68 57	72 12	22	19
20	64 39	71 48	27	65 41	71 39	26	66 44	71 31	25	67 47	71 23	24	68 51	71 16	22	20
21	64 30	70 54	27	65 32	70 45	26	66 35	70 36	25	67 39	70 27	24	68 43	70 20	23	21
22	64 20	70 0	27	65 23	69 50	26	66 26	69 41	25	67 30	69 32	24	68 35	69 24	23	22
23	64 10	69 6	27	65 13	68 56	27	66 17	68 46	25	67 21	68 36	24	68 26	68 28	24	23
24	64 0	68 12	28	65 3	68 2	27	66 7	67 51	26	67 12	67 41	25	68 17	67 32	24	24
25	63 49	67 18	28	64 53	67 8	27	65 57	66 57	26	67 2	66 46	25	68 7	66 36	24	25
26	63 37	66 24	29	64 42	66 14	27	65 46	66 2	27	66 51	65 51	25	67 57	65 40	24	26
27	63 25	65 30	29	64 30	65 20	28	65 35	65 8	27	66 40	64 56	26	67 46	64 45	25	27
28	63 13	64 36	30	64 18	64 26	28	65 24	64 13	27	66 39	64 1	26	67 35	63 50	25	28
29	63 1	63 42	31	64 6	63 32	29	65 12	63 19	28	66 18	63 6	27	67 24	62 55	25	29
30	62 48	62 49	32	63 54	62 37	29	65 0	62 24	28	66 6	62 11	27	67 12	61 59	26	30
31	62 34	61 56	33	63 41	61 43	30	64 46	61 30	29	65 52	61 16	28	66 59	61 4	27	31
32	62 18	61 3	34	63 26	60 49	31	64 31	60 35	29	65 38	60 21	28	66 45	60 9	27	32
33	62 2	60 10	35	63 10	59 55	31	64 16	59 40	30	65 23	59 26	29	66 31	59 14	28	33
34	61 46	59 17	36	62 54	59 1	33	64 1	58 46	31	65 8	58 32	29	66 17	58 19	28	34
35	61 29	58 24	37	62 37	58 8	34	63 45	57 52	31	64 53	57 38	30	66 2	57 23	29	35
36	61 12	57 32	38	62 20	57 15	35	63 28	56 58	32	64 37	56 44	31	65 46	56 28	29	36
37	60 54	56 40	39	62 3	56 22	36	63 11	56 5	33	64 20	55 50	31	65 29	55 33	30	37
38	60 35	55 48	39	61 45	55 29	37	62 53	55 12	34	64 3	54 56	32	65 12	54 38	31	38
39	60 15	54 56	40	61 26	54 37	38	62 35	54 19	35	63 45	54 2	33	64 54	53 44	31	39
40	59 53	54 4	40	61 6	53 45	39	62 16	53 26	36	63 26	53 8	34	64 35	52 50	32	40
41	59 30	53 12	41	60 33	52 52	40	61 54	52 32	38	63 6	52 14	35	64 15	51 56	33	41
42	59 6	52 20	41	60 18	52 0	40	61 31	51 39	39	62 44	51 20	36	63 54	51 2	34	42
43	58 41	51 28	42	59 53	51 8	41	61 7	50 46	40	62 20	50 27	37	63 33	50 8	35	43
44	58 15	50 36	42	59 27	50 16	42	60 41	49 54	41	61 56	49 35	38	63 10	49 15	36	44
45	57 48	49 45	43	59 1	49 24	42	60 15	49 2	41	61 30	48 42	39	62 46	48 22	37	45

Longitude from Vertex.	LATITUDE OF VERTEX. 66° Lat.	Course.	Dist.	67° Lat.	Course.	Dist.	68° Lat.	Course.	Dist.	69° Lat.	Course.	Dist.	70° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	57 21	48 54	43	58 34	48 32	43	59 48	48 10	42	61 4	47 49	40	62 21	47 28	38	46
47	56 52	48 4	45	58 6	47 41	43	59 20	47 18	42	60 37	46 56	41	61 55	46 35	40	47
48	56 22	47 14	46	57 36	46 50	45	58 51	46 26	43	60 9	46 4	42	61 28	45 42	41	48
49	55 50	46 24	47	57 5	45 59	46	58 21	45 35	44	59 40	45 12	43	60 59	44 49	42	49
50	55 17	45 34	48	56 33	45 9	47	57 50	44 44	45	59 9	44 20	44	60 29	43 57	43	50
51	54 42	44 44	50	55 59	44 18	49	57 17	43 53	47	58 37	43 28	45	59 58	43 5	45	51
52	54 6	43 56	52	55 24	43 28	50	56 43	43 3	49	58 4	42 37	47	59 25	42 13	46	52
53	53 29	43 8	54	54 48	42 40	52	56 7	42 13	51	57 29	41 46	49	58 50	41 21	48	53
54	52 51	42 20	56	54 10	41 51	55	55 30	41 23	52	56 52	40 56	51	58 14	40 30	49	54
55	52 11	41 33	58	53 30	41 3	57	54 51	40 34	54	56 13	40 6	52	57 36	39 39	51	55
56	51 30	40 46	59	52 49	40 16	58	54 10	39 46	56	55 23	39 17	54	56 56	38 49	53	56
57	50 46	39 59	60	52 6	39 28	60	53 27	38 58	58	54 42	38 28	56	56 14	37 59	55	57
58	50 0	39 13	63	51 21	38 41	62	52 43	38 10	60	54 0	37 39	58	55 30	37 9	58	58
59	49 12	38 27	65	50 33	37 54	64	51 56	37 22	63	53 16	36 51	60	54 44	36 20	60	59
60	48 21	37 42	67	49 43	37 8	67	51 6	36 35	67	52 30	36 3	65	53 57	35 32	63	60
61	47 27	37 59	69	48 50	36 22	68	50 13	35 48	68	51 38	35 15	67	53 6	34 44	65	61
62	46 31	36 16	71	47 54	35 37	70	49 17	35 2	70	50 43	34 28	69	52 12	33 57	67	62
63	45 32	35 33	73	46 55	34 53	72	48 19	34 17	71	49 46	33 42	70	51 16	33 10	69	63
64	44 31	34 50	75	45 54	34 10	74	47 19	33 33	74	48 46	32 57	73	50 17	32 23	72	64
65	43 29	34 7	77	44 52	33 28	77	46 17	32 50	77	47 44	32 12	76	49 16	31 36	76	65
66	42 25	33 27	82	43 47	32 47	82	45 12	32 8	81	46 39	31 29	81	48 12	30 50	80	66
67	41 17	32 47	85	42 38	32 6	85	44 3	31 26	85	45 30	30 46	84	47 4	30 6	84	67
68	40 5	32 7	87	41 26	31 26	87	42 50	30 45	87	44 17	30 4	87	45 51	29 23	87	68
69	38 50	31 28	92	40 10	30 46	92	41 34	30 4	92	43 1	29 22	91	44 34	28 41	91	69
70	37 31	30 50	94	38 51	30 6	94	40 15	29 23	94	41 42	28 41	95	43 13	28 0	95	70
71	36 9	30 13	100	37 28	29 27	100	38 52	28 43	100	40 19	28 1	100	41 47	27 20	100	71
72	34 44	29 38	103	36 2	28 51	104	37 25	28 6	104	38 51	27 23	104	40 18	26 41	104	72
73	33 16	29 5	106	34 32	28 17	109	35 54	27 31	109	37 19	26 46	109	38 45	26 3	109	73
74	31 45	28 33	109	32 59	27 44	113	34 19	26 56	113	35 42	26 10	114	37 7	25 25	114	74
75	30 10	28 3	113	31 22	27 13	118	32 39	26 24	118	34 0	25 36	119	35 25	24 49	119	75
76	28 31	27 35	118	29 41	26 44	124	30 55	25 54	124	32 14	25 5	126	33 38	24 17	125	76
77	26 48	27 8	124	27 56	26 16	126	29 7	25 25	127	30 23	24 35	130	31 45	23 46	130	77
78	25 2	26 41	126	26 6	25 48	128	27 14	24 56	130	28 27	24 5	135	29 46	23 15	135	78
79	23 12	26 15	128	24 12	25 22	130	25 17	24 29	135	26 26	23 37	140	27 41	22 45	140	79
80	21 18	25 50	130	22 15	24 57	133	23 16	24 4	140	24 21	23 9	145	25 31	22 16	145	80
81	19 21	25 27	132	20 15	24 32	136	21 11	23 39	144	22 10	22 42	149	23 16	21 48	150	81
82	17 21	25 10	134	18 11	24 13	140	19 2	23 16	147	19 55	22 20	153	20 56	21 24	155	82
83	15 18	24 53	137	16 3	23 55	143	16 49	22 58	150	17 36	22 1	156	18 31	21 4	160	83
84	13 12	24 40	140	13 51	23 42	146	14 32	22 44	153	15 13	21 46	159	16 2	20 48	165	84
8	11 4	24 29	142	11 36	23 30	148	12 11	22 31	155	12 49	21 33	162	13 28	20 35	168	85
8	8 54	24 21	144	9 19	23 22	150	9 48	22 23	157	10 21	21 24	164	10 51	20 26	170	86
8	6 42	24 14	146	7 0	23 15	152	7 23	22 16	159	7 51	21 17	166	8 12	20 18	172	87
8	4 29	24 9	148	4 40	23 9	154	4 57	22 9	161	5 17	21 10	168	5 30	20 10	174	88
8	2 15	24 4	149	2 20	23 4	156	2 29	22 4	163	2 40	21 4	170	2 46	20 4	177	89
9	0 . 0	24 0		0 0	23 0		0 0	22 0		0 0	21 0		0 0	20 0		90

Longitude from Vertex.	LATITUDE OF VERTEX.															Longitude from Vertex.
	71°			72°			73°			74°			75°			
	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	71 0	90 0	20	72 0	90 0	19	73 0	90 0	18	74 0	90 0	17	75 0	90 0	16	0
1	71 0	89 2	20	72 0	89 2	19	73 0	89 2	18	74 0	89 1	17	75 0	89 1	16	1
2	70 59	88 5	20	71 59	88 5	19	72 59	88 4	18	73 59	88 3	17	74 59	88 3	16	2
3	70 58	87 9	20	71 58	87 8	19	72 58	87 6	18	73 59	87 6	17	74 59	87 6	16	3
4	70 57	86 12	20	71 57	86 11	19	72 57	86 9	18	73 58	86 8	17	74 58	86 8	16	4
5	70 56	85 16	20	71 56	85 14	19	72 56	85 12	18	73 57	85 10	17	74 57	85 10	16	5
6	70 54	84 19	20	71 54	84 17	19	72 54	84 15	18	73 55	84 13	17	74 55	84 12	16	6
7	70 52	83 22	20	71 52	83 20	19	72 52	83 17	18	73 53	83 15	17	74 53	83 14	16	7
8	70 50	82 25	20	71 50	82 23	19	72 50	82 20	18	73 51	82 17	17	74 51	82 16	16	8
9	70 47	81 29	21	71 47	81 26	20	72 48	81 23	18	73 49	81 20	17	74 49	81 18	16	9
10	70 44	80 33	21	71 44	80 29	20	72 45	80 26	18	73 46	80 23	17	74 47	80 21	16	10
11	70 40	79 36	21	71 40	79 32	20	72 42	79 29	19	73 43	79 25	17	74 44	79 23	16	11
12	70 36	78 40	21	71 36	78 36	20	72 38	78 32	19	73 39	78 28	17	74 41	78 25	16	12
13	70 32	77 43	21	71 32	77 39	20	72 34	77 35	19	73 35	77 30	18	74 37	77 27	16	13
14	70 28	76 47	21	71 28	76 42	20	72 30	76 37	19	73 31	76 33	18	74 33	76 29	16	14
15	70 23	75 51	21	71 24	75 46	20	72 26	75 40	19	73 27	75 36	18	74 29	75 32	16	15
16	70 18	74 54	21	71 19	74 49	20	72 21	74 43	19	73 22	74 39	18	74 25	74 34	16	16
17	70 12	73 58	21	71 14	73 52	20	72 16	73 46	19	73 17	73 41	18	74 20	73 36	17	17
18	70 6	73 2	22	71 8	72 56	21	72 10	72 49	19	73 12	72 43	18	74 15	72 38	17	18
19	70 0	72 5	22	71 2	71 59	21	72 4	71 52	20	73 7	71 46	19	74 10	71 40	17	19
20	69 53	71 8	22	70 55	71 2	21	71 58	70 55	20	73 2	70 48	19	74 5	70 42	17	20
21	69 46	70 12	22	70 48	70 5	21	71 51	69 58	20	72 56	69 51	19	73 59	69 44	18	21
22	69 38	69 15	22	70 41	69 8	22	71 44	69 1	20	72 49	68 53	19	73 53	68 46	18	22
23	69 30	68 19	22	70 34	68 11	22	71 37	68 4	20	72 42	67 56	19	73 47	67 49	18	23
24	69 22	67 23	22	70 26	67 15	22	71 30	67 7	20	72 35	66 59	19	73 40	66 51	18	24
25	69 13	66 27	23	70 18	66 19	22	71 22	66 11	21	72 27	66 2	20	73 32	65 54	19	25
26	69 3	65 31	23	70 8	65 22	22	71 13	65 14	21	72 19	65 5	20	73 24	64 56	19	26
27	68 53	64 35	23	69 58	64 26	22	71 4	64 17	21	72 10	64 8	20	73 16	63 58	19	27
28	68 42	63 39	24	69 48	63 30	23	70 54	63 21	22	72 1	63 11	20	73 7	63 1	19	28
29	68 31	62 44	24	69 38	62 34	23	70 44	62 24	22	71 51	62 14	20	72 58	62 4	20	29
30	68 20	61 48	25	69 27	61 37	23	70 34	61 27	22	71 41	61 17	21	72 48	61 7	20	30
31	68 7	60 53	25	69 15	60 41	24	70 23	60 31	23	71 30	60 20	21	72 38	60 10	20	31
32	67 54	59 57	26	69 2	59 45	24	70 11	59 34	23	71 19	59 23	22	72 27	59 13	21	32
33	67 40	59 2	26	68 49	58 49	25	69 59	58 37	24	71 7	58 26	22	72 16	58 16	21	33
34	67 26	58 6	27	68 36	57 53	26	69 46	57 41	25	70 55	57 29	23	72 5	57 19	22	34
35	67 12	57 10	27	68 22	56 57	26	69 32	56 44	25	70 42	56 32	23	71 53	56 21	23	35
36	66 57	56 14	28	68 7	56 1	27	69 17	55 47	26	70 28	55 35	24	71 40	55 24	23	36
37	66 41	55 18	28	67 52	55 5	27	69 2	54 51	26	70 14	54 38	25	71 26	54 27	24	37
38	66 24	54 23	29	67 36	54 9	28	68 47	53 55	27	70 0	53 42	26	71 12	53 30	25	38
39	66 6	53 27	29	67 19	53 13	28	68 31	52 59	28	69 45	52 46	26	70 58	52 33	26	39
40	65 48	52 32	31	67 1	52 17	30	68 14	52 3	29	69 29	51 50	28	70 43	51 36	27	40
41	65 29	51 38	32	66 42	51 22	31	67 56	51 7	30	69 12	50 54	29	70 26	50 40	27	41
42	65 8	50 44	33	66 22	50 27	32	67 37	50 12	31	68 54	49 58	30	70 9	49 43	28	42
43	64 47	49 50	33	66 2	49 32	32	67 18	49 16	31	68 36	49 2	30	69 51	48 47	29	43
44	64 26	48 56	34	65 42	48 38	33	66 59	48 21	32	68 17	48 6	31	69 33	47 51	29	44
45	64 3	48 2	35	65 20	47 44	33	66 38	47 26	32	67 57	47 10	31	69 15	46 55	30	45

Longitude from Vertex.	LATITUDE OF VERTEX.																					Longitude from Vertex.
	71°					72°				73°				74°				75°				
	Lat.		Course.		Dist.	Lat.		Course.		Dist.	Lat.		Course.		Dist.	Lat.		Course.		Dist.	Lat.		Course.		Dist.	
46	63	39	47	8	36	64	57	46	49	34	66	16	46	31	33	67	35	46	15	32	68	55	45	59	31	46
47	63	14	46	14	39	64	33	45	55	37	65	53	45	37	35	67	13	45	20	33	68	34	45	3	31	47
48	62	48	45	21	40	64	8	45	1	38	65	29	44	42	36	66	50	44	24	34	68	12	44	7	32	48
49	62	20	44	28	41	63	41	44	7	39	65	3	43	48	37	66	25	43	29	35	67	48	43	11	33	49
50	61	50	43	35	42	63	12	43	13	40	64	35	42	54	38	65	59	42	34	36	67	23	42	16	34	50
51	61	19	42	42	44	62	42	42	20	42	64	6	42	6	40	65	31	41	39	38	66	57	41	21	36	51
52	60	47	41	49	45	62	11	41	27	44	63	36	41	6	42	65	2	40	44	40	66	30	40	26	38	52
53	60	13	40	57	47	61	38	40	34	46	63	4	40	12	44	64	31	39	50	42	66	1	39	31	40	53
54	59	37	40	5	48	61	3	39	41	47	62	30	39	18	45	63	59	38	56	43	65	30	38	36	41	54
55	59	0	39	13	50	60	26	38	48	48	61	54	38	24	46	63	25	38	2	44	64	58	37	42	42	55
56	58	21	38	22	52	59	48	37	56	50	61	17	37	32	48	62	50	37	9	46	64	24	36	48	44	56
57	57	40	37	31	54	59	8	37	5	52	60	39	36	40	50	62	13	36	16	48	63	48	35	54	46	57
58	56	57	36	41	57	58	27	36	14	55	59	59	35	48	53	61	34	35	23	51	63	10	35	0	49	58
59	56	13	35	51	59	57	44	35	23	57	59	17	34	56	55	60	53	34	31	53	62	30	34	7	51	59
60	55	27	35	2	60	56	59	34	33	59	58	34	34	5	57	60	11	33	39	55	61	49	33	14	53	60
61	54	38	34	13	64	56	11	33	43	62	57	48	33	14	60	59	26	32	47	58	61	5	32	22	56	61
62	53	46	33	24	66	55	20	32	53	65	56	58	32	24	63	58	38	31	56	61	60	18	31	30	59	62
63	52	51	32	36	68	54	26	32	4	67	56	5	31	34	65	57	46	31	5	63	59	28	30	38	61	63
64	51	52	31	48	71	53	28	31	15	70	55	8	30	44	68	56	50	30	14	66	58	34	29	46	64	64
65	50	50	31	0	75	52	27	30	26	74	54	7	29	54	72	55	50	29	23	70	57	37	28	54	68	65
66	49	45	30	13	79	51	23	29	38	78	53	3	29	5	76	54	47	28	33	74	56	36	28	3	72	66
67	48	36	29	27	83	50	15	28	51	82	51	57	28	17	81	53	41	27	44	79	55	31	27	13	77	67
68	47	24	28	43	86	49	3	28	6	85	50	40	27	31	84	52	31	26	56	83	54	23	26	24	81	68
69	46	8	28	1	90	47	47	27	23	89	49	32	26	46	88	51	18	26	10	87	53	11	25	36	85	69
70	44	48	27	20	94	46	28	26	41	93	48	12	26	3	92	50	1	25	25	91	51	55	24	49	90	70
71	43	23	26	39	99	45	4	25	59	99	46	48	25	20	98	48	38	24	41	97	50	33	24	3	96	71
72	41	54	25	59	103	43	34	25	18	103	45	18	24	37	103	47	9	23	57	102	49	5	23	17	102	72
73	40	20	25	20	109	41	59	24	37	109	43	43	23	55	109	45	33	23	14	109	47	30	22	32	109	73
74	38	40	24	41	115	40	18	23	57	115	42	1	23	13	116	43	51	22	31	117	45	48	21	48	118	74
75	36	55	24	3	120	38	32	23	17	121	40	13	22	32	122	42	2	21	48	123	44	0	21	5	125	75
76	35	5	23	27	126	36	40	22	39	127	38	21	21	53	128	40	9	21	7	130	42	5	20	25	132	76
77	33	9	22	53	132	34	42	22	3	134	36	21	21	16	136	38	7	20	29	138	40	1	19	46	140	77
78	31	7	22	21	141	32	37	21	29	143	34	13	20	41	144	35	57	19	53	146	37	48	19	9	149	78
79	29	0	21	51	146	30	25	20	58	150	31	45	20	8	153	33	38	19	19	156	35	27	18	33	158	79
80	26	46	21	22	151	28	7	20	29	157	29	36	19	37	161	31	12	18	47	166	32	57	17	58	168	80
81	24	26	20	54	156	25	43	20	1	164	27	6	19	8	169	28	37	18	16	176	30	17	17	24	177	81
82	22	0	20	28	161	23	11	19	34	171	24	29	18	40	177	25	53	17	46	183	27	27	16	54	187	82
83	19	29	20	6	165	20	34	19	10	177	21	44	18	15	182	23	2	17	20	190	24	27	16	28	197	83
84	16	53	19	49	169	17	50	18	52	180	18	53	17	56	187	20	2	17	0	197	21	13	16	6	206	84
85	14	12	19	37	173	15	1	18	39	183	15	54	17	42	192	16	54	16	46	204	18	1	15	48	214	85
86	11	29	19	27	177	12	9	18	29	187	12	53	17	31	197	13	42	16	33	209	14	37	15	34	220	86
87	8	39	19	18	180	9	10	18	19	190	9	44	17	20	201	10	22	16	21	213	11	4	15	22	225	87
88	5	48	19	10	183	6	8	18	10	193	6	31	17	10	204	6	56	16	10	216	7	25	15	11	229	88
89	2	54	19	4	186	3	4	18	4	196	3	16	17	4	207	3	29	16	4	219	3	44	15	4	233	89
90	0	0	19	0		0	0	18	0		0	0	17	0		0	0	16	0		0	0	15	0		90

Longitude from Vertex.	LATITUDE OF VERTEX.																				Longitude from Vertex.
	76°			77°			78°			79°			80°								
	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.	Lat.	Course.	Dist.						
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′						°
0	76 0	90 0	15	77 0	90 0	13	78 0	90 0	12	79 0	90 0	11	80 0	90 0	10						0
1	76 0	89 1	15	77 0	89 1	13	78 0	89 0	12	79 0	89 0	11	80 0	89 0	10						1
2	75 59	88 2	15	76 59	88 2	13	77 59	88 1	12	78 59	88 1	11	79 59	88 1	10						2
3	75 59	87 4	15	76 59	87 3	13	77 59	87 3	12	78 59	87 2	11	79 59	87 2	10						3
4	75 58	86 6	15	76 58	86 5	13	77 58	86 4	12	78 58	86 3	11	79 58	86 3	10						4
5	75 57	85 8	15	76 57	85 7	14	77 57	85 6	12	78 57	85 5	11	79 58	85 4	10						5
6	75 56	84 9	15	76 56	84 8	14	77 56	84 7	12	78 56	84 6	11	79 57	84 5	10						6
7	75 54	83 11	15	76 54	83 9	14	77 55	83 8	13	78 55	83 7	11	79 56	83 6	10						7
8	75 52	82 13	16	76 52	82 11	14	77 53	82 9	13	78 54	82 8	11	79 55	82 7	10						8
9	75 50	81 15	16	76 50	81 13	14	77 51	81 11	13	78 52	81 10	11	79 53	81 8	10						9
10	75 48	80 17	16	76 48	80 15	15	77 49	80 13	13	78 50	80 11	11	79 51	80 9	10						10
11	75 46	79 19	16	76 45	79 17	15	77 47	79 14	13	78 48	79 12	12	79 49	79 10	10						11
12	75 43	78 21	16	76 42	78 19	15	77 44	78 16	13	78 46	78 13	12	79 47	78 11	10						12
13	75 39	77 23	16	76 39	77 20	15	77 41	77 17	13	78 43	77 14	12	79 45	77 12	10						13
14	75 35	76 25	16	76 36	76 22	15	77 38	76 19	13	78 40	76 16	12	79 42	76 13	11						14
15	75 31	75 27	16	76 33	75 24	15	77 35	75 20	13	78 37	75 17	12	79 39	75 14	11						15
16	75 27	74 29	16	76 29	74 26	15	77 31	74 22	14	78 34	74 18	12	79 36	74 15	11						16
17	75 23	73 31	16	76 25	73 28	15	77 27	73 24	14	78 30	73 20	12	79 33	73 16	11						17
18	75 18	72 33	16	76 21	72 29	15	77 23	72 25	14	78 26	72 21	12	79 30	72 17	11						18
19	75 13	71 35	16	76 17	71 30	16	77 19	71 26	14	78 22	71 22	13	79 26	71 18	11						19
20	75 8	70 37	16	76 21	70 32	16	77 15	70 27	15	78 18	70 24	13	79 22	70 19	12						20
21	75 3	69 39	16	76 7	69 34	16	77 10	69 28	15	78 14	69 25	13	79 18	69 20	12						21
22	74 57	68 41	17	76 2	68 36	16	77 5	68 29	15	78 9	68 26	13	79 14	68 21	12						22
23	74 51	67 43	17	75 56	67 38	16	77 0	67 30	15	78 4	67 28	14	79 10	67 22	12						23
24	74 45	66 45	17	75 50	66 40	16	76 55	66 31	15	77 59	66 29	14	79 5	66 23	12						24
25	74 39	65 47	17	75 44	65 42	16	76 49	65 33	16	77 54	65 30	14	79 0	65 24	13						25
26	74 31	64 50	18	75 37	64 44	16	76 43	64 34	16	77 48	64 32	14	78 54	64 25	13						26
27	74 23	63 52	18	75 30	63 46	17	76 36	63 36	16	77 42	63 33	14	78 48	63 26	13						27
28	74 14	62 54	18	75 22	62 48	17	76 29	62 38	16	77 36	62 34	15	78 42	62 28	13						28
29	74 5	61 56	18	75 14	61 50	17	76 22	61 40	16	77 29	61 36	15	78 36	61 29	14						29
30	73 56	60 58	19	75 6	60 52	18	76 14	60 42	16	77 22	60 37	15	78 30	60 30	14						30
31	73 46	60 1	19	74 57	59 54	18	76 6	59 44	17	77 14	59 38	15	78 23	59 31	14						31
32	73 36	59 4	19	74 47	58 56	18	75 57	58 46	17	77 6	58 39	16	78 16	58 32	14						32
33	73 26	58 7	20	74 37	57 58	18	75 48	57 48	17	76 58	57 41	16	78 9	57 34	15						33
34	73 16	57 10	21	74 27	57 1	19	75 39	56 50	18	76 50	56 42	16	78 1	56 35	15						34
35	73 5	56 12	22	74 16	56 3	19	75 29	55 51	18	76 41	55 43	17	77 53	55 36	15						35
36	72 53	55 14	23	74 5	55 3	19	75 18	54 53	18	76 31	54 44	17	77 44	54 37	16						36
37	72 40	54 17	23	73 53	54 6	20	75 6	53 55	19	76 20	53 46	17	77 34	53 38	16						37
38	72 27	53 20	24	73 41	53 8	21	74 54	52 57	19	76 9	52 49	18	77 24	52 40	16						38
39	72 13	52 23	24	73 28	52 11	22	74 42	52 0	19	75 58	51 51	18	77 13	51 42	17						39
40	71 59	51 26	25	73 15	51 13	22	74 29	51 2	20	75 46	50 53	19	77 2	50 44	17						40
41	71 43	50 29	26	73 1	50 16	23	74 16	50 5	21	75 33	49 55	19	76 50	49 46	18						41
42	71 27	49 32	27	72 45	49 18	24	74 2	49 7	22	75 20	48 57	20	76 38	48 48	18						42
43	71 10	48 35	27	72 29	48 20	25	73 48	48 9	23	75 7	47 59	20	76 26	47 50	19						43
44	70 53	47 38	28	72 13	47 25	25	73 33	47 12	23	74 53	47 1	21	76 13	46 51	19						44
45	70 36	46 41	28	71 57	46 28	26	73 18	46 15	24	74 39	46 3	22	76 0	45 52	20						45

Longitude from Vertex.	LATITUDE OF VERTEX. 76° Lat.	Course.	Dist.	77° Lat.	Course.	Dist.	78° Lat.	Course.	Dist.	79° Lat.	Course.	Dist.	80° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	70 15	45 43	29	71 36	45 29	26	72 58	45 16	24	74 20	45 4	23	75 46	44 53	21	46
47	69 55	44 47	29	71 17	44 32	27	72 40	44 19	25	74 6	44 6	23	75 31	43 55	22	47
48	69 34	43 51	30	70 57	43 36	28	72 21	43 22	25	73 48	43 9	24	75 15	42 57	23	48
49	69 12	42 55	31	70 36	42 40	29	72 1	42 26	26	73 29	42 12	24	74 58	41 59	24	49
50	68 48	42 0	32	70 14	41 45	30	71 41	41 30	27	73 10	41 15	25	74 40	41 1	25	50
51	68 23	41 4	33	69 51	40 48	31	71 20	40 32	28	72 50	40 17	26	74 21	40 3	26	51
52	67 57	40 7	34	69 27	39 50	32	70 58	39 34	29	72 29	39 19	27	74 1	39 5	27	52
53	67 30	39 11	36	69 2	38 52	34	70 34	38 37	30	72 7	38 22	28	73 40	38 7	28	53
54	67 2	38 16	38	68 36	37 58	36	70 9	37 41	31	71 44	37 25	29	73 18	37 10	28	54
55	66 33	37 23	39	68 8	37 4	38	69 43	36 46	33	71 19	36 29	31	72 55	36 13	29	55
56	66 2	36 28	41	67 38	36 9	40	69 15	35 51	35	70 52	35 33	33	72 31	35 16	31	56
57	65 29	35 33	43	67 6	35 13	42	68 45	34 54	37	70 23	34 36	35	72 5	34 19	34	57
58	64 53	34 38	46	66 31	34 17	44	68 12	33 57	40	69 52	33 39	37	71 37	33 22	36	58
59	64 12	33 44	49	65 52	33 22	46	67 35	33 2	43	69 19	32 43	39	71 7	32 25	38	59
60	63 29	32 50	51	65 11	32 28	49	66 56	32 7	46	68 44	31 47	42	70 35	31 28	40	60
61	62 44	31 57	53	64 28	31 34	51	66 15	31 12	49	68 7	30 51	44	70 1	30 32	42	61
62	61 57	31 4	56	63 43	30 40	53	65 33	30 17	51	67 28	29 56	47	69 24	29 36	44	62
63	61 8	30 11	59	62 57	29 46	56	64 49	29 23	53	66 47	29 1	49	68 45	28 40	46	63
64	60 18	29 18	61	62 9	28 53	59	64 6	28 29	55	66 4	28 6	52	68 4	27 44	49	64
65	59 26	28 26	64	61 19	28 0	61	63 16	27 35	58	65 17	27 11	55	67 21	26 48	53	65
66	58 30	27 35	68	60 26	27 8	64	62 24	26 41	61	64 26	26 16	59	66 34	25 53	57	66
67	57 30	26 44	72	59 29	26 16	68	61 27	25 48	64	63 31	25 22	62	65 43	24 58	61	67
68	56 24	25 54	77	58 26	25 25	72	60 26	24 56	68	62 32	24 29	66	64 48	24 4	65	68
69	55 12	25 5	82	57 16	24 35	79	59 20	24 5	76	61 30	23 37	73	63 48	23 18	70	69
70	53 54	24 17	87	55 59	23 46	84	58 9	23 15	81	61 24	22 45	78	62 44	22 16	76	70
71	52 31	23 30	93	54 37	22 57	90	56 52	22 25	87	59 11	21 55	84	61 34	21 22	82	71
72	51 3	22 43	99	53 10	22 9	96	55 25	21 35	93	57 51	21 3	91	60 17	20 29	89	72
73	49 29	21 58	106	51 38	21 21	103	53 58	20 46	100	56 23	20 12	98	58 53	19 37	97	73
74	47 50	21 10	115	50 0	20 33	112	52 21	19 57	109	54 48	19 22	107	57 22	18 47	105	74
75	46 7	20 25	122	48 17	19 46	120	50 37	19 9	118	53 6	18 33	117	55 44	17 58	116	75
76	44 28	19 42	130	46 27	19 1	128	48 45	18 23	127	51 14	17 46	125	53 57	17 10	126	76
77	42 23	19 1	139	44 22	18 18	138	46 42	17 36	138	49 10	17 0	138	51 59	16 23	139	77
78	40 13	18 22	150	42 12	17 37	151	44 22	16 57	152	46 56	16 16	152	49 47	15 37	152	78
79	37 51	17 45	160	39 52	16 59	162	41 56	16 16	164	44 28	15 33	166	47 27	14 51	167	79
80	35 16	17 10	171	37 22	16 23	174	39 15	15 37	177	42 13	14 51	180	45 0	14 6	184	80
81	32 25	16 36	183	34 27	15 48	188	36 21	15 0	193	39 11	14 12	198	41 56	13 22	203	81
82	29 25	16 4	193	31 20	15 14	199	33 13	14 24	205	35 52	13 34	212	38 33	12 41	222	82
83	26 13	15 36	205	28 0	14 44	214	29 50	13 52	223	32 17	13 0	232	34 51	12 5	243	83
84	22 51	15 12	218	24 29	14 18	230	26 11	13 24	242	28 24	13 30	254	30 48	11 35	266	84
85	19 20	14 52	229	20 45	13 56	244	22 18	13 0	259	24 14	12 5	265	26 23	11 10	291	85
86	15 40	14 37	238	16 51	13 40	256	18 10	12 43	274	19 47	11 46	292	21 38	10 50	310	86
87	11 52	14 24	245	12 48	13 26	265	13 50	12 28	285	15 4	11 30	305	16 33	10 33	325	87
88	7 58	14 12	250	8 36	13 13	272	9 19	12 14	293	10 11	11 15	314	11 12	10 16	336	88
89	3 1	14 4	255	4 20	13 4	277	4 42	12 4	299	5 8	11 4	321	5 39	10 4	342	89
90	0	14 0		0 0	13 0		0 0	12 0		0 0	11 0		0 0	10 0		90

Longitude from Vertex.	LATITUDE OF VERTEX. 81° Lat.	Course.	Dist.	82° Lat.	Course.	Dist.	83° Lat.	Course.	Dist.	84° Lat.	Course.	Dist.	85° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	81 0	90 0	0	82 0	90 0	7	83 0	90 0	6	84 0	90 0	5	85 0	90 0	4	0
1	81 0	89 0	8	82 0	89 0	7	83 0	89 0	6	84 0	89 0	5	85 0	89 0	4	1
2	80 59	88 1	8	81 59	88 1	7	82 59	88 1	6	84 0	88 0	5	85 0	88 0	4	2
3	80 59	87 2	8	81 59	87 1	7	82 59	87 1	6	83 59	87 1	5	84 59	87 0	4	3
4	80 58	86 2	9	81 58	86 2	7	82 58	86 2	6	83 59	86 1	5	84 59	86 1	4	4
5	80 58	85 3	9	81 58	85 2	8	82 58	85 2	6	83 58	85 1	5	84 59	85 1	4	5
6	80 57	84 4	9	81 57	84 3	8	82 57	84 3	6	83 58	84 1	5	84 58	84 1	4	6
7	80 56	83 5	9	81 56	83 4	8	82 57	83 3	7	83 57	83 2	5	84 58	83 1	4	7
8	80 55	82 6	9	81 55	82 5	8	82 56	82 4	7	83 57	82 3	5	84 58	82 2	4	8
9	80 54	81 6	9	81 54	81 5	8	82 55	81 4	7	83 56	81 3	6	84 57	81 2	4	9
10	80 52	80 7	9	81 53	80 5	8	82 54	80 5	7	83 56	80 3	6	84 57	80 2	5	10
11	80 50	79 8	9	81 51	79 6	8	82 52	79 5	7	83 55	79 4	6	84 56	79 2	5	11
12	80 48	78 9	9	81 49	78 7	8	82 50	78 5	7	83 53	78 4	6	84 55	78 3	5	12
13	80 46	77 10	9	81 47	77 8	8	82 48	77 6	7	83 51	77 4	6	84 53	77 3	5	13
14	80 44	76 11	9	81 45	76 9	8	82 46	76 6	7	83 49	76 5	6	84 51	76 3	5	14
15	80 41	75 12	9	81 43	75 10	8	82 44	75 7	7	83 47	75 5	6	84 49	75 4	5	15
16	80 38	74 12	9	81 40	74 10	8	82 42	74 7	8	83 45	74 5	6	84 48	74 4	5	16
17	80 35	73 13	9	81 37	73 11	8	82 40	73 8	8	83 43	73 6	6	84 46	73 4	5	17
18	80 32	72 14	9	81 34	72 11	8	82 38	72 8	8	83 41	72 6	7	84 44	72 5	5	18
19	80 29	71 15	9	81 31	71 12	8	82 35	71 9	8	83 39	71 6	7	84 42	71 6	5	19
20	80 25	70 16	9	81 28	70 12	9	82 32	70 9	8	83 36	70 7	7	84 40	70 6	5	20
21	80 21	69 17	9	81 25	69 13	9	82 29	69 10	8	83 34	69 7	7	84 38	69 6	6	21
22	80 17	68 17	9	81 22	68 14	9	82 26	68 10	8	83 32	68 8	7	84 36	68 6	6	22
23	80 13	67 18	9	81 19	67 14	9	82 23	67 11	8	83 29	67 8	7	84 34	67 6	6	23
24	80 9	66 19	10	81 15	66 15	9	82 20	66 11	8	83 26	66 8	7	84 32	66 6	6	24
25	80 5	65 20	10	81 11	65 15	9	82 17	65 12	8	83 23	65 9	8	84 29	65 6	6	25
26	80 0	64 21	10	81 7	64 16	9	82 13	64 12	8	83 20	64 9	8	84 26	64 7	6	26
27	79 55	63 22	10	81 2	63 16	9	82 9	63 13	8	83 17	63 9	8	84 23	63 7	6	27
28	79 50	62 22	10	80 57	62 17	9	82 5	62 14	9	83 13	62 10	8	84 20	62 7	7	28
29	79 45	61 23	10	80 52	61 18	9	82 1	61 14	9	83 9	61 10	8	84 17	61 7	7	29
30	79 39	60 24	10	80 47	60 19	9	81 56	60 15	9	83 5	60 10	8	84 14	60 7	7	30
31	79 33	59 26	11	80 42	59 19	9	81 51	59 15	9	83 1	59 11	8	84 10	59 8	7	31
32	79 27	58 26	11	80 36	58 20	9	81 46	58 16	9	82 57	58 11	8	84 5	58 8	7	32
33	79 20	57 26	11	80 30	57 21	10	81 41	57 16	9	82 52	57 12	8	84 2	57 8	8	33
34	79 13	56 28	11	80 24	56 22	10	81 36	56 17	9	82 47	56 12	9	83 58	56 8	8	34
35	79 6	55 28	12	80 18	55 23	10	81 30	55 17	9	82 42	55 13	9	83 54	55 9	8	35
36	78 57	54 29	12	80 10	54 24	10	81 23	54 18	9	82 36	54 13	9	83 49	54 9	8	36
37	78 48	53 31	12	80 2	53 25	11	81 16	53 19	10	82 30	53 14	9	83 44	53 10	8	37
38	78 39	52 33	13	79 54	52 26	11	81 9	52 19	10	82 24	52 14	9	83 39	52 10	8	38
39	78 29	51 33	13	79 45	51 27	11	81 1	51 20	10	82 18	51 15	9	83 34	51 11	8	39
40	78 19	50 35	14	79 36	50 28	12	80 53	50 21	10	82 11	50 15	9	83 29	50 11	8	40
41	78 8	49 35	14	79 26	49 29	12	80 45	49 21	11	82 4	49 15	9	83 23	49 11	8	41
42	77 57	48 37	15	79 16	48 30	13	80 37	48 22	11	81 57	48 17	9	83 17	48 12	9	42
43	77 46	47 38	16	79 6	47 31	14	80 29	47 23	12	81 50	47 17	10	83 11	47 12	9	43
44	77 35	46 41	17	78 56	46 32	15	80 21	46 24	12	81 43	46 18	10	83 4	46 13	9	44
45	77 23	45 42	18	78 46	45 33	16	80 12	45 25	13	81 35	45 17	11	82 57	45 13	9	45

Longitude from Vertex.	LATITUDE OF VERTEX. 81° Lat.	Course.	Dist.	82° Lat.	Course.	Dist.	83° Lat.	Course.	Dist.	84° Lat.	Course.	Dist.	85° Lat.	Course.	Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	77 13	44 43	19	78 35	44 34	17	79 58	44 26	14	81 23	44 18	12	82 49	44 14	10	46
47	77 1	43 44	20	78 23	43 34	18	79 47	43 26	15	81 13	43 18	13	82 41	43 14	10	47
48	76 45	42 45	21	78 10	42 35	18	79 36	42 26	15	81 3	42 19	13	82 33	42 14	11	48
49	76 28	41 46	21	77 56	41 35	18	79 24	41 26	16	80 53	42 19	14	82 24	41 14	12	49
50	76 10	40 48	22	77 41	40 36	19	79 12	40 27	16	80 43	40 20	14	82 15	40 15	12	50
51	75 51	39 50	23	77 25	39 37	20	78 59	39 29	17	80 32	39 21	15	82 6	39 15	13	51
52	75 32	38 51	24	77 8	38 39	21	78 44	38 30	18	80 20	38 22	15	81 56	38 16	13	52
53	75 13	37 53	25	76 50	37 40	22	78 28	37 31	19	80 7	37 22	16	81 45	37 16	14	53
54	74 54	36 56	25	76 31	36 42	22	78 11	36 32	19	79 52	36 23	17	81 33	36 17	15	54
55	74 34	35 58	26	76 12	35 45	23	77 53	35 34	20	79 36	35 25	17	81 20	35 18	16	55
56	74 13	35 0	28	75 52	34 47	25	77 35	34 36	22	79 20	34 26	19	81 7	34 19	17	56
57	73 50	34 3	30	75 31	33 49	27	77 16	33 37	24	79 3	33 27	21	80 53	33 20	18	57
58	73 25	33 6	32	75 9	32 51	28	76 56	32 38	25	78 46	32 28	22	80 38	32 21	19	58
59	72 57	32 8	34	74 45	31 52	30	76 36	31 39	26	78 28	31 29	23	80 22	31 22	20	59
60	72 27	31 10	36	74 20	30 54	32	76 14	30 41	28	78 9	30 31	25	80 5	30 23	22	60
61	71 55	30 12	38	73 53	29 56	34	75 50	29 43	30	77 48	29 32	26	79 47	29 24	23	61
62	71 21	29 14	40	73 23	28 59	36	75 23	28 45	32	77 25	28 33	28	79 27	28 25	24	62
63	70 45	28 15	41	72 50	28 1	37	74 54	27 47	33	76 59	27 34	29	79 6	27 26	25	63
64	70 7	27 19	44	72 14	27 4	39	74 22	26 49	34	76 31	26 36	30	78 43	26 27	26	64
65	69 27	26 22	48	71 36	26 7	43	73 47	25 51	38	76 1	25 38	33	78 18	25 28	29	65
66	68 45	25 27	52	70 55	25 10	47	73 10	24 53	42	75 29	24 40	37	77 52	24 29	32	66
67	68 0	24 32	55	70 12	24 13	50	72 31	23 55	45	74 55	23 42	40	77 23	23 30	35	67
68	67 10	23 37	60	69 26	23 16	54	71 50	22 58	48	74 18	22 44	42	76 52	22 31	37	68
69	66 13	22 42	64	68 36	22 20	58	71 5	22 1	52	73 38	21 46	46	76 17	21 33	40	69
70	65 9	21 48	72	67 40	21 24	65	70 15	21 4	60	72 55	20 48	52	75 39	20 35	44	70
71	64 1	20 54	78	66 39	20 28	71	69 20	20 6	64	72 7	19 49	57	74 57	19 37	49	71
72	62 52	20 1	83	65 32	19 34	78	68 20	19 10	71	71 13	18 52	63	74 12	18 39	54	72
73	61 33	19 8	92	64 20	18 40	86	67 13	18 15	78	70 14	17 56	70	73 20	17 42	60	73
74	60 7	18 16	100	62 59	17 46	94	65 54	17 20	86	69 8	17 0	77	72 23	16 45	67	74
75	58 32	17 24	110	61 30	16 54	104	64 36	16 28	96	67 54	16 6	86	71 20	15 48	75	75
76	56 47	16 36	122	59 51	16 4	115	63 6	15 36	107	66 31	15 12	98	70 7	14 52	85	76
77	54 51	15 48	135	58 0	15 14	128	61 22	14 44	121	64 57	14 18	110	68 45	13 56	97	77
78	52 42	15 0	149	55 57	14 24	144	59 26	13 52	136	63 11	13 24	125	67 11	13 0	112	78
79	50 18	14 12	165	53 37	13 34	161	57 14	13 0	154	61 9	12 30	144	65 22	12 5	129	79
80	48 4	13 22	184	51 27	12 41	182	55 9	12 5	176	59 12	11 38	166	63 37	11 10	152	80
81	45 0	12 35	205	48 25	11 50	205	52 13	11 14	202	56 26	10 47	193	61 5	10 17	179	81
82	41 35	11 53	228	45 0	11 4	231	48 51	10 27	231	53 12	9 57	227	58 6	9 26	214	82
83	37 47	11 15	253	41 9	10 25	261	45 0	9 46	266	49 21	9 11	266	54 32	8 36	258	83
84	33 34	10 42	279	36 47	9 53	294	40 34	9 8	306	45 0	8 27	313	50 13	7 48	314	84
85	3 55	10 16	290	31 54	9 24	314	35 28	8 35	337	39 46	7 46	365	45 0	7 4	382	85
86	23 49	9 54	334	26 27	9 0	362	29 40	8 7	396	33 39	7 14	429	39 38	6 24	464	86
87	18 19	9 35	356	20 27	8 38	376	23 7	7 42	415	26 30	6 45	465	30 55	5 50	551	87
88	12 26	9 17	374	13 57	8 18	401	15 52	7 19	445	18 22	6 20	529	21 45	5 23	631	88
89	6 17	9 4	381	7 4	8 4	471	8 5	7 4	535	9 26	6 4	604	11 17	5 6	679	89
90	0	9 0		0 0	8 0		0 0	7 0		0 0	6 0		0 0	5 0		90

Longitude from Vertex.	LATITUDE OF VERTEX. 86° Lat.	86° Course.	86° Dist.	87° Lat.	87° Course.	87° Dist.	88° Lat.	88° Course.	88° Dist.	89° Lat.	89° Course.	89° Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
0	86 0	90 0	3	87 0	90 0	3	88 0	90 0	2	89 0	90 0	1	0
1	86 0	89 0	3	87 0	89 0	3	88 0	89 0	2	89 0	89 0	1	1
2	86 0	88 0	3	87 0	88 0	3	88 0	88 0	2	89 0	88 0	1	2
3	86 0	87 0	3	87 0	87 0	3	88 0	87 0	2	89 0	87 0	1	3
4	85 59	86 1	4	87 0	86 0	3	88 0	86 0	2	89 0	86 0	1	4
5	85 59	85 1	4	86 59	85 0	3	88 0	85 0	2	89 0	85 0	1	5
6	85 59	84 1	4	86 59	84 0	3	87 59	84 0	2	88 59	84 0	1	6
7	85 58	83 1	4	86 59	83 0	3	87 59	83 0	2	88 59	83 0	1	7
8	85 58	82 1	4	86 58	82 1	3	87 59	82 0	2	88 59	82 0	1	8
9	85 57	81 1	4	86 58	81 1	3	87 58	81 0	2	88 59	81 0	1	9
10	85 57	80 2	4	86 57	80 1	3	87 58	80 0	2	88 58	80 0	1	10
11	85 56	79 2	4	86 57	79 1	3	87 57	79 0	2	88 58	79 0	1	11
12	85 55	78 2	4	86 56	78 1	3	87 57	78 1	2	88 58	78 0	1	12
13	85 54	77 2	5	86 55	77 1	3	87 56	77 1	2	88 57	77 0	1	13
14	85 53	76 2	5	86 54	76 1	3	87 56	76 1	2	88 57	76 0	1	14
15	85 52	75 3	5	86 53	75 2	3	87 55	75 1	2	88 56	75 0	1	15
16	85 51	74 3	5	86 52	74 2	4	87 55	74 1	2	88 56	74 0	1	16
17	85 50	73 3	5	86 51	73 2	4	87 54	73 1	2	88 55	73 0	1	17
18	85 48	72 3	5	86 50	72 2	4	87 53	72 1	2	88 55	72 0	1	18
19	85 46	71 3	5	86 49	71 2	4	87 52	71 1	2	88 54	71 0	1	19
20	85 44	70 4	5	86 48	70 3	4	87 51	70 1	2	88 54	70 0	1	20
21	85 42	69 4	5	86 47	69 3	4	87 50	69 1	2	88 53	69 0	1	21
22	85 40	68 4	5	86 46	68 3	4	87 49	68 1	2	88 53	68 0	1	22
23	85 39	67 4	5	86 45	67 3	4	87 48	67 1	2	88 52	67 0	1	23
24	85 37	66 4	5	86 43	66 3	4	87 47	66 1	3	88 52	66 0	1	24
25	85 35	65 4	6	86 41	65 3	4	87 46	65 1	3	88 51	65 0	1	25
26	85 33	64 5	6	86 39	64 3	4	87 45	64 1	3	88 51	64 0	1	26
27	85 31	63 5	6	86 38	63 3	4	87 44	63 1	3	88 50	63 0	1	27
28	85 28	62 5	6	86 36	62 3	4	87 43	62 1	3	88 50	62 0	1	28
29	85 26	61 5	6	86 34	61 4	4	87 42	61 1	3	88 49	61 0	1	29
30	85 23	60 6	6	86 32	60 4	5	87 41	60 1	3	88 49	60 0	1	30
31	85 20	59 6	6	86 30	59 4	5	87 39	59 2	3	88 48	59 0	2	31
32	85 17	58 6	6	86 28	58 4	5	87 37	58 2	3	88 47	58 0	2	32
33	85 14	57 7	6	86 26	57 4	5	87 35	57 2	3	88 46	57 0	2	33
34	85 11	56 7	6	86 24	56 4	5	87 33	56 2	3	88 45	56 0	2	34
35	85 7	55 7	6	86 21	55 4	5	87 31	55 2	3	88 44	55 0	2	35
36	85 3	54 8	6	86 19	54 4	5	87 29	54 2	4	88 43	54 0	2	36
37	84 59	53 8	7	86 16	53 5	5	87 27	53 2	4	88 41	53 0	2	37
38	84 55	52 8	7	86 13	52 5	5	87 25	52 2	4	88 39	52 0	2	38
39	84 51	51 9	7	86 10	51 5	5	87 23	51 2	4	88 37	51 0	2	39
40	84 47	50 9	7	86 6	50 5	5	87 21	50 2	4	88 35	50 0	2	40
41	84 42	49 9	7	86 3	49 5	5	87 19	49 2	4	88 33	49 0	2	41
42	84 37	48 10	7	86 0	48 5	5	87 16	48 2	4	88 32	48 0	2	42
43	84 32	47 10	8	85 56	47 5	6	87 13	47 2	5	88 30	47 0	2	43
44	84 27	46 10	8	85 52	46 5	6	87 10	46 2	5	88 28	46 1	2	44
45	84 21	45 10	8	85 49	45 6	6	87 6	45 2	5	88 26	45 1	2	45

Longitude from Vertex.	LATITUDE OF VERTEX. 86° Lat.	86° Course.	86° Dist.	87° Lat.	87° Course.	87° Dist.	88° Lat.	88° Course.	88° Dist.	89° Lat.	89° Course.	89° Dist.	Longitude from Vertex.
°	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	° ′	° ′	′	°
46	84 15	44 11	8	85 43	44 6	6	87 2	44 2	5	88 24	44 1	2	46
47	84 9	43 11	8	85 38	43 6	6	86 58	43 2	6	88 22	43 1	2	47
48	84 2	42 11	10	85 33	42 6	7	86 53	42 3	6	88 20	42 1	3	48
49	83 55	41 11	10	85 28	41 6	7	86 49	41 3	7	88 18	41 1	3	49
50	83 48	40 12	10	85 22	40 6	8	86 45	40 3	7	88 15	40 1	3	50
51	83 41	39 12	11	85 15	39 6	8	86 40	39 3	8	88 13	39 1	3	51
52	83 32	38 12	11	85 10	38 6	9	86 35	38 3	8	88 10	38 1	3	52
53	83 22	37 12	11	85 2	37 7	9	86 30	37 3	9	88 8	37 1	3	53
54	83 13	36 13	12	84 54	36 7	9	86 25	36 3	9	88 5	36 1	3	54
55	83 3	35 13	12	84 45	35 7	10	86 20	35 3	10	88 2	35 1	4	55
56	82 52	34 14	13	84 36	34 7	10	86 15	34 3	10	88 0	34 1	4	56
57	82 41	33 15	14	84 27	33 8	11	86 10	33 4	11	87 57	33 1	4	57
58	82 29	32 16	15	84 18	32 8	12	86 4	32 4	11	87 54	32 1	4	58
59	82 16	31 17	16	84 9	31 8	13	85 58	31 4	12	87 51	31 1	4	59
60	82 2	30 18	17	84 0	30 8	14	85 52	30 4	12	87 48	30 1	5	60
61	81 47	29 20	18	83 50	29 9	15	85 46	29 4	13	87 45	29 1	5	61
62	81 32	28 21	19	83 39	28 9	16	85 39	28 4	13	87 42	28 1	5	62
63	81 15	27 22	20	83 27	27 10	17	85 32	27 5	14	87 39	27 1	6	63
64	80 56	26 23	21	83 13	26 10	18	85 24	26 5	14	87 35	26 1	6	64
65	80 36	25 24	22	82 56	25 11	19	85 15	25 5	15	87 31	25 1	7	65
66	80 15	24 25	25	82 38	24 12	20	85 5	24 5	15	87 26	24 1	7	66
67	79 51	23 26	28	82 22	23 12	21	84 54	23 6	16	87 21	23 1	8	67
68	79 26	22 27	31	82 2	22 13	23	84 42	22 6	17	87 16	22 1	8	68
69	78 58	21 28	34	81 40	21 13	26	84 28	21 6	18	87 11	21 1	9	69
70	78 27	20 29	37	81 17	20 14	27	84 13	20 7	19	87 5	20 1	9	70
71	77 53	19 31	40	80 51	19 14	31	83 55	19 7	20	86 57	19 2	10	71
72	77 15	18 33	44	80 22	18 15	34	83 35	18 7	23	86 47	18 2	12	72
73	76 33	17 34	49	79 50	17 16	38	83 13	17 8	25	86 36	17 2	13	73
74	75 46	16 36	55	79 14	16 17	42	82 49	16 8	29	86 23	16 2	15	74
75	74 53	15 37	63	78 33	15 18	48	82 20	15 9	33	86 8	15 2	17	75
76	73 53	14 39	71	77 47	14 20	56	81 47	14 10	38	85 50	14 2	19	76
77	72 44	13 41	82	76 53	13 21	63	81 11	13 11	43	85 34	13 2	22	77
78	71 25	12 43	94	75 51	12 23	74	80 26	12 13	52	85 12	12 2	26	78
79	69 52	11 45	111	74 39	11 25	88	79 37	11 14	61	84 46	11 3	31	79
80	68 4	10 48	131	73 12	10 26	106	78 39	10 16	74	84 16	10 3	38	80
81	65 55	9 53	158	71 29	9 29	129	77 25	9 17	91	83 39	9 3	47	81
82	63 20	8 59	193	69 22	8 32	160	75 55	8 18	115	82 51	8 4	61	82
83	60 9	8 6	239	66 45	7 37	203	74 1	7 19	150	81 51	7 4	81	83
84	56 13	7 14	299	63 22	6 42	265	71 32	6 26	203	80 31	6 5	111	84
85	51 15	6 23	353	58 59	5 50	354	68 10	5 38	286	78 41	5 6	163	85
86	44 56	5 39	522	53 5	5 0	488	63 25	4 28	429	75 57	4 7	265	86
87	36 49	5 0	627	44 58	4 15	679	56 17	3 37	679	71 33	3 10	488	87
88	26 31	4 28	708	33 40	3 37	916	44 59	3 18	1107	63 26	2 14	1107	88
89	14 1	4 7	840	18 25	3 10	1107	26 33	2 14	1593	45 0	1 25	2700	89
90	0	4 0		0 0	3 0		0 0	2 0		0 0	1 0		90

EXPLANATION.

1. Every Great Circle divides the surface of a sphere into two equal parts, and is called a Great Circle, because it is the largest that can be drawn on the sphere, its radius being that of the sphere itself; and, since each Great Circle divides the sphere into two equal parts or hemispheres, it must also divide any other Great Circle into two equal parts or semicircles.

2. The Equator, being a Great Circle of the Earth, therefore bisects every other Great Circle on its surface. Both the northern and southern halves of a Great Circle must have in each hemisphere a point of greatest separation from the Equator, and equally distant from it: either of these points is called the 'Vertex' of the Great Circle to which it belongs; the arc intercepted between the Vertex and the Equator is called the 'Latitude of Vertex;' the meridian that passes through the Vertex, the 'Meridian of Vertex;' and the arc of the Equator contained between the 'Meridian of Vertex' and the meridian of any place on the Great Circle, is named the 'Longitude from Vertex.'

3. The Meridian of the Vertex always intersects the Great Circle at right angles, and, with the Equator, divides a Great Circle into quadrants; and in each of these quadrants the elements are the same; that is, the latitudes, courses, and distances, corresponding to each degree of longitude from the vertex in one quadrant, truly represent those for the corresponding degree in each quadrant belonging to the same Great Circle.

4. The shortest distance between any two places on the Earth's surface is on a Great Circle; consequently, that ship alone, which steers along the arc of a Great Circle, sails directly for her port.

5. Mercator and Parallel Sailings conduct the ship by a circuitous route, when compared with the track of a Great Circle; but the simplicity of the calculations connected with those sailings, and the circumstance that, by them, the ship makes but one course throughout the voyage, have led to their being preferred to Great-Circle Sailing, in which the course is continually changing. To determine, by calculation, how much the course must be changed from time to time, has been a problem so tedious and so often to be repeated as to preclude its being generally adopted. This difficulty is entirely obviated by the preceding Tables, by which the calculations connected with Great-Circle Sailing are reduced to a matter of mere inspection, when the 'Latitude of Vertex' and the 'Longitude from Vertex' are known. The accompanying 'Linear Index' is so constructed as to determine these two elements with great ease and simplicity.

Description of the Linear Index.

6. The 'Linear Index' is a plate or diagram separate from the Tables, and is intended to be kept in the chart-box. It contains the 'Scale of Difference of Longitude,' as well as a time scale for 'Azimuths' (of which hereafter), and both of which are constructed on the same principle as a 'Diagonal Scale of Equal Parts.' Above these scales is a series of curves, each bearing reference to a parallel of latitude. Every fifth curve is distinguished by being darker than the others. These curves are intersected by 89 'Index Lines,' which show the 'Latitude of Vertex' of the Great Circle the elements of which are required to be known. Every fifth Index Line is numbered in both margins.

7. Both the curves and 'Index Lines' are numbered from the top downwards.

8. The curves are also intersected vertically by two lines: the one towards the right hand is called the 'Meridian of the Vertex,' the other the 'Equator.'

Description of the Tables.

9. The Tables contain the latitude, course, and distance for every degree of longitude of 89 Great Circles, distinguished from each other by the latitudes of their vertices. The top of each column on the left-hand pages of the Tables corresponds to the part of the Great Circle intersected by the 'Meridian of the Vertex;' while the bottom of each column on the right-hand pages corresponds to the part intersected by the 'Equator.'

To find the Latitude of Vertex, and the Longitude from Vertex, by means of the Linear Index.

10. With a pair of compasses take out the difference of longitude from the scale of 'Difference of Longitude' in the 'Linear Index,' in the same manner as divisions and proportional parts are taken out from the ordinary diagonal scale of equal parts; the largest divisions being regarded as 10° each, the smaller divisions as 1° each, and the smallest divisions shown by the intersections of the parallel lines by the diagonals as the tenth of a degree or six minutes each. For example: To open the compasses to the difference of longitude 85° 24′. Set one foot at 80, and the other extended to the lower end of the fifth diagonal line gives 85°; now follow up the fifth diagonal line to the fourth long parallel line numbered 24 at the left end of the scale, and, fixing the point there, extend the other point to meet the line that rises at 80; this will be the measure required.

11. Next, when both the latitudes of the ship and her destination have the same name (N. or S.), set the *right* point of the compasses, in the division of the diagram nearest to the *right hand*, on that curve the number of which represents the latitude * either of the ship or of her destination, whichever may be the *nearer to the Equator; and keeping the line of the two points exactly parallel with the index lines*, follow this curve up or down till the *left* point meets the curve answering to the other latitude,* taking care that both points of the compasses shall be equally near to the same index line and on the same side of it; and the degree of latitude represented by the index line nearest to the points of the compasses must be taken as the latitude of the vertex required. Whenever the latitudes are of the same name, and that the difference of longitude exceeds 90°, ——at care must be taken that the 'Equator' line be not included between the nts of the compasses.

* The nearest whole degree of latitude to that of the ship's place, or of her destination, may be here loyed.

12. If these latitudes have unlike names (the one N. and the other S.), place one point of the compasses, in the division of the diagram nearest to the *left hand*, on the curve representing the latitude * either of the ship or of her destination, whichever may be the *nearer to the Equator;* then move the compasses along the curve till the other point meets the curve of the other latitude * *on the right hand side of the 'Equator' line*, observing the same precautions in regard to other matters as are given in the last article.

13. In either case, before the points of the compasses are withdrawn from the curves, it is important to observe the vertical line or lines, if any, which are between the points of the compasses, and note the circumstance: thus, for Lat. of Vertex 51°, if neither line be within, say—Lat. of Vertex 51°, 'both out;' if the Meridian of Vertex be within — Lat. of Vertex 51°, 'Mer. in;' if the Equator be within — Lat. of Vertex 51°, 'Equator in;' or, if both lines be within — Lat. of Vertex 51°, 'Mer. and Equator in' or 'Equator and Mer. in,' according as the Meridian of Vertex or the Equator is nearer to the ship's place.†

14. The Latitude of Vertex being thus found, let one point of the compasses remain on the curve of the latitude of the ship's place, and bring the other point to the vertical line 'Meridian of Vertex,' opening or closing the compasses as may be necessary; the distance thus taken by the compasses, being applied to the scale of difference of longitude, will show the 'Longitude from Vertex.'†

The preceding directions for finding the longitude from Vertex refer to a case of the curve representing the ship's latitude, being in either division of the diagram to the *right* of the Equator line; but should that curve be to the *left* of the Equator, the left marginal line must be regarded as the Meridian of Vertex. See (20).

To find the Great Circle Course, having by means of the Linear Index found the Latitude of Vertex and the Longitude from Vertex.

15. Open the Tables at the part corresponding to the Latitude of Vertex; and, in the column 'Course,' agreeing with the Longitude from Vertex in the side-column, will be found the course required.

16. Put the course N. or S. according as the port to which the ship is sailing is N. or S., except in cases of 'Mer. in' or 'Mer. and Equator in,' when the course must be N. or S. according as the Latitude of the ship is N. or S.‡ But, in all cases, the course must be E. or W. according as the port bound to is E. or W. of the ship.

17. If the ship could be kept on the arc of a Great Circle during the whole voyage the 'Latitude of Vertex' would be constantly the same, and consequently the several courses would at once be shown by the Table adjacent to the ship's latitude, from time to time, during the whole voyage; but this is impracticable, at least for a sailing vessel: and, moreover, if it were practicable, it would not always be expedient, since sometimes it would be desirable to keep the ship away, as by sailing free she would near her port more quickly than by sailing close-hauled on the shorter route. It is therefore desirable that the course should be frequently ascertained in the manner described above; so that if the

* The nearest whole degree of latitude to that of the ship's place, or of her destination, may be here employed.

† This distinction is only required for ascertaining from which pole the course in the Table is to be reckoned (16).

‡ It will be observed that with 'Equator and Meridian in' the course will be N. or S. according as the port is N. or S., this not being an exception (13).

Latitude of the Vertex be changed, the part of the Tables from which the next course is to be taken shall be changed with it. By taking this precaution the effect of any deviation from the track of a Great Circle will be reduced to the smallest possible amount.

18. EXAMPLE I.—Ship's place, Barbados, Lat. 13° 19′ N., Long. 59° 40′ W., bound to the Lizard, Lat. 49° 58′ N., Long. 5° 12′ W.; required the first course on a Great Circle?

Open the compasses to the difference of longitude 54° 30′ by the scale of difference of longitude (10,) and apply the distance to the curves 13°* and 30°* (11,) when the Latitude of Vertex will be found to be 53°, '*both out*' (13). Let one point of the compasses remain upon the curve 13°, at the point at which it has just been applied, and bring the other point to the vertical line 'Meridian of Vertex,' as before directed (14): this distance, applied to the scale of difference of longitude, will give 80° as the Longitude from Vertex.

Next, turn to the Table 'Lat. of Vertex' 53°; and corresponding to 'Long. from Vertex' 80°, we shall have under 'Course' 38° 7′, which is N. 38° 7′ E., because the Lizard is N. and E. of the ship.

19. EXAMPLE II.—Ship's place, Cape of Good Hope, Lat. 34° 22′ S., Long. 18° 30′ E., bound to Rio Janeiro, Lat. 22° 55′ S., Long. 43° 9′ W.; required the first Great-Circle course.

In this example we find the Lat. of Vertex to be 35°, and Long. from Vertex 9°, and consequently the course is 84° 52′. But in determining the 'Lat. of Vertex' the 'Meridian of Vertex' comes between the points of the compasses, and, consequently the course is S., because the Lat. is S., although the port bound to is N. (16.)

20. EXAMPLE III.—Ship's place, Acapulco, Lat. 16° 51′ N., Long. 99° 52′ W., bound for Port Jackson, Lat. 33° 51′ S., Long. 151° 18′ E.; required the first Great-Circle course?

Having taken out the difference of Long. 108° 50′ in the compasses, set one point on the curve 17° in the division of the diagram left of the 'Equator,' and move the point of the compasses along this curve till the other point meets the curve 34°, on the right-hand side of the 'Equator;' when we shall find the Lat. of Vertex to be 34°. Then let the point on the curve 17° remain, and bring the other point to the *left-hand marginal line* (14); the distance thus taken being applied to the 'Scale of Difference of Longitude' will give the Long. from Vertex 63°. The course given in the Table will therefore be S. 60° 8′ W. It is S. and W. because the port bound to is S. and W. of the ship's place; the 'Equator in' is not an exception to this general rule.

21. EXAMPLE IV.—Ship's place, Port Jackson, bound to Panama, Lat. 8° 57′ N., Long. 79° 31′ W.; required the first Great-Circle course?

In this example the port bound to *being nearer the Equator* than the ship's place, the left point of the compasses must be set on the curve 9° *in the division of the diagram left of the Equator* (12); the right-hand point of the compasses will meet the curve 34 on the right-hand side of the Meridian of Vertex; it is therefore a case of 'Mer. and Equator in,' and the course is S., although the port bound to is N. of the ship (16).† The Latitude of Vertex is thus shown to be

* The nearest whole degree of latitude will give the result sufficiently near the truth.

† It will be observed that, with 'Equator and Meridian in,' the course will be N. or S., according the port is N. or S.; this not being an exception (13).

37°, and Longitude from Vertex 27°, and consequently the first course to be steered is S. 74° 8′ E.

To trace the track of a Great Circle on a Chart, having by means of the Linear Index found the Latitude of the Vertex, and the Longitude from the Vertex.

22. Write down the longitude of the ship's place, and immediately below it write the Longitude from the Vertex of the same point (14); then on the right of the first longitude write in succession the longitudes of the meridians on the chart through which the track must pass, and immediately below these the several corresponding Longitudes from the Vertex. In doing this it will be observed that the Longitudes from the Vertex will vary successively by the same amount as the longitudes of the meridians; but the one set may successively increase while the other decreases, or they may both increase or decrease together: this circumstance, with reference to the Longitudes from the Vertex, will be regulated by the following considerations: (*viz.*)—

(1.) When 'both out,' the Longitudes from Vertex will successively decrease or increase according as the ship's place is nearer to or further from the Equator.
(2.) When 'Mer. in,' they will first decrease, but after passing the vertex will increase.
(3.) When 'Equator in,' they will increase till reaching 90°, and then decrease.
(4.) When 'Mer. and Equator in,' they will be as Nos (2) and (3) combined; or 'Equator and Mer. in,' they will be as Nos. (3) and (2) combined.

23. Having written the two lines of corresponding longitudes, as above directed, next under each of the 'Longitudes from Vertex' write the corresponding latitudes as given by the Table; then mark the several meridians on the chart at the respective points of latitude thus written under each, and a line drawn through these points will be the track required.

24. Example V.—Between Barbados, Lat. 13° 19′ N., Long. 59° 40′ W., and the Lizard, Lat. 49° 58′ N., Long. 5° 12′ W., required the latitude at which the track of the Great Circle intersects each meridian on a chart which has every fifth degree of longitude drawn on it?

Having by means of the Linear Index (11, 13, and 14) ascertained that the *Lat. of Vertex is* 53°, '*both out,*' and that the *Longitude from Vertex is* 80°, we proceed as follows:—

Long. from Greenwich	60° W.	55° W.	50° W.	45° W.	40° W.	35° W.
Long. from Vertex .	80	75	70	65	60	55
Latitude	13° 0′ N.	18° 56′ N.	24° 25′ N.	29° 14′ N.	33° 32′ N.	37° 18′ N.
Long. from Greenwich	30° W.	25° W.	20° W.	15° W.	10° W.	5° W.
Long. from Vertex .	50	45	40	35	30	25
Latitude	40° 27′ N.	43° 10′ N.	45° 30′ N.	47° 22′ N.	49° 0′ N.	50° 16′ N.

25. EXAMPLE VI.—Between Cape Race, Lat. 46° 40′ N., Long. 53° 7′ W., and the Lizard, Lat. 49° 58′ N., Long. 5° 12′ W., required the latitude at which the track of the Great Circle intersects each meridian on a chart which has every fifth degree of longitude drawn on it?

Lat. of Vertex 51°, '*Mer in.*' (11 and 13.)

Long. from Greenwich	53° W.	50° W.	45° W.	40° W.	35° W.	30° W.
Long. from Vertex -	31	28	23	18	13	8
Latitude - - - -	46°38′N.	47°28′N.	48°39′N.	49°35′N.	50°16′N.	50°42′N.

Long. from Greenwich	25° W.	20° W.	15° W.	10° W.	5° W.
Long. from Vertex -	3	2	7	12	17
Latitude - - - -	50°57′N.	50°58′N.	50°46′N.	50°22′N.	49°44′N.

26. EXAMPLE VII.—Between St. Helena, Lat. 15° 55′ S., Long. 5° 43′ W., and Bermuda, Lat. 32° 22′ N., Long. 64° 30′ W., required the latitude at which the track of the Great Circle intersects each meridian on a chart which has every tenth degree of longitude drawn on it?

Lat. of Vertex 44°, '*Equator in.*' (12 and 13.)

Long. from Greenwich	6° W.	15° W.	25° W.	35° W.	45° W.	55° W.	64° W.
Long. from Vertex -	73	82	88	78	68	58	49
Latitude - - - -	15°45′S.	7°41′S.	1°56′N.	11°22′N.	19°53′N.	27°5′N.	32°19′N.

27. EXAMPLE VIII.—Between Panama, Lat. 8° 57′ N., Long. 79° 31′ W., and Port Jackson, Lat. 33° 51′ S., Long. 151° 18′ E., required the latitude at which the track of the Great Circle intersects each meridian on a chart which has every tenth degree of longitude drawn on it?

Lat. of Vertex 37°, '*Equator and Mer. in.*' (12 and 13.)

Long. from Greenwich	79° W.	80° W.	90° W.	100° W.	110° W.	120° W.	130° W.	140° W.
Long. from Vertex	78	79	89	81	71	61	51	41
Latitude - - -	8°55′N.	8°13′N.	0°46′N.	6°46′S.	13°46′S.	20°4′S.	25°22′S.	29°38′S.

ıg. from Greenwich	150° W.	160° W.	170° W.	180°	170° E.	160° E.	151° E.
ıg. from Vertex -	31	21	11	1	9	19	28
itude - - - -	32°51′S.	35°8′ S.	36°29′S.	36°59′S.	36°40′S.	35°28′S.	33°37′S.

To find the Distance.

28. Each distance, as given in the Tables, is the number of miles required to be run from the degree of longitude against which it is placed to the next degree further from the Vertex; and, consequently, the sum of the distances corresponding to each of the degrees of longitude through which the ship has passed gives the miles run nearly: on the other hand, by knowing the distance run and inverting the rule, we can find the ship's place nearly; but, if the distance be considerable, the addition of many small amounts will be attended with more trouble than the adoption of the following simple rule: however, it must be observed that to ascertain the exact distance requires that the Latitude of the Vertex should be ascertained more accurately than for any of the other practical applications of the Tables.

29. To find the distance between the ship and her destination. To the log. sine of the latitudes of the ship's place and her destination, add separately the log. cosecant of the Latitude of the Vertex, rejecting 10. The sums will be the log. cosines of two arcs, which will give the distance, subject to the following conditions:—

In cases where we have
'Both out,' take the difference of the arcs.
'Meridian in,' the sum.
'Equator in,' the supplement of the sum.
'Meridian and Equator in' or 'Equator and Meridian in,' the supplement of the difference.

30. EXAMPLE IX.—Required the distance between the Lizard and Barbados. *Lat. of Vertex* 53°, '*both out*'?

	°	′				°	′		
Lat. of Lizard	49	58	N. sin	9·884042	Lat. of Barbados	13	19	N. sin	9·362356
Lat. of Vertex	53	0	cosec	0·097651					0·097651
	16	31	cos	9·981693		73	14	cos	9·460007
	73	14							
	56	43	difference						
		60							
Distance	3403	miles							

31. EXAMPLE X.—Required the distance between Valparaiso and Port Jackson. *Lat. of Vertex* 61°, '*Meridian in*'?

	°	′				°	′		
Lat. of Valparaiso	33	0	S. sin	9·736109	Lat. of Port Jack.	33	51	S. sin	9·745871
Lat. of Vertex	61	0	cosec	0·058181					0·058181
	51	29	cos	9·794290		50	26	cos	9·804052
	50	26							
	101	55	sum						
		60							
Distance	6115	miles							

32. EXAMPLE XI.—Required the distance between the Columbia River and Port Jackson. *Lat. of Vertex* 52°, '*Equator in*'?

	°	′					°	′		
Lat. of Col. Riv.	46	0	N. sin	9·856934	Lat. of Port Jack.	33	51	S. sin	9·745871
Lat. of Vertex	52	0	cosec	0·103468					0·103468
	24	6	cos	9·960402		45	1	cos	9·849339
	45	1							
	69	7							
	180	0							
	110	53	supplement of sum						
	60								

Distance 6653 miles

33. EXAMPLE XII.—Required the distance between Port Jackson and Panama. *Lat. of Vertex* 37°, '*Meridian and Equator in*'?

	°	′					°	′		
Lat. of Port Jack.	33	51	S. sin	9·745871	Lat. of Panama	8	57	N. sin	9·191933
Lat. of Vertex	37	0	cosec	0·220537					0·220537
	22	15	cos	9·966408		75	1	cos	9·412470
						22	15		
						52	46		
						180	0		
						127	14	supp. of diff.	
						60			

Distance 7634 miles

Windward Great-Circle Sailing.

34. When a ship cannot (on account of adverse winds) sail directly to her port, she obviously ought to be put on that tack by which she nears her port by the greatest proportion of the distance sailed. It is also evident that she must do this when her track deviates by the least amount from the direct line which connects her with her destination, or, in other words, when she is put on that tack which deviates less from the true course than the other tack. In adopting this rule, it must, however, be especially borne in mind, that the *true course* alone can serve as a guide in choosing the tack; and that the Great Circle, and not the Rhumb, is the *true course*. But, since the mariner is more conversant with the Rhumb than the Great Circle, too much attention cannot be directed to the importance of making this distinction between these two courses in connexion with Windward Sailing. In crossing the Pacific, the Rhumb course frequently deviates four points from the ıe course; under such circumstances it is impossible that the mariner can navigate ı vessel with advantage, if he fail to make himself acquainted with the Great- rcle course.

The term "Windward Great-Circle Sailing" is employed with special reference these facts. This new form of describing the application of the *true course* is dered necessary on account of the prevalent erroneous opinions—that "to a

sailing vessel, Great-Circle Sailing is of comparatively little value;" and that "steamers, being in a measure independent of the winds, could more readily than sailing vessels avail themselves of the advantages of Great-Circle Sailing." The reverse is the fact: to a sailing vessel the advantage of being guided by the true course, when contending with adverse winds, is fourfold as great as that which is conferred on a steamer. Thus, for example, the increase of distance arising from the direct track being diverted two points is only 1 mile in 12; but, if a ship that sails six points from the wind deviate two points further from the angle of the true position of her port on account of the wrong course being employed, she cannot in the least degree near her port, whilst, under the same circumstances, the knowledge of the true course would enable the mariner so to choose his track as to make good $8\frac{1}{2}$ miles by a run of 12 miles.

35. The rule for Windward Great-Circle Sailing is as follows. Ascertain the Great-Circle course (10 and 16), and put the ship on that tack which is the nearer to the Great-Circle course.

36. EXAMPLE XIII.—At Port Jackson, Lat. 33° 51′ S., Long. 151° 18′ E., bound to Valparaiso, Lat. 33° S., Long. 71° 40′ W., wind S. 63° E.; on which tack ought the ship to be put?

Lat. of Vertex 61°, Long. of Port Jackson from Vertex 68°, Great-Circle course by Tables S. 35° 48′ E.: consequently, the port tack must be preferred, because the port tack and Great-Circle course are nearer to each other than the starboard tack and Great-Circle course. Now, if the ship could sail 66° from the wind, the port tack would be S. 3° W.; and, the destination on the chart being N. 89° 34′ E., this tack appears as if it would lead the ship away from her port: yet it will be found that a run of 750 miles on this tack would bring the ship 592 miles nearer to Valparaiso, while the same number of miles on the starboard tack would only reduce the distance 296 miles, although on the chart it appears as if it would shorten the distance by double that amount.

37. EXAMPLE XIV.—Being at the entrance of the English Channel, in Lat. 49° 15′ N., Long. 5° 5′ W., and bound to New York, in Lat. 40° 41′ N., Long. 74° 5′ W., wind W. during the whole voyage, ship sailing 150 miles per diem and 65° from the wind; on which tack is it most advantageous that the ship should be put during each successive day of the voyage?

The following Daily Reckonings will afford an illustration of a voyage conducted on the principle of Windward Great-Circle Sailing, as contrasted with the same voyage conducted on the principle of Rhumb Sailing. The reason for selecting a case in which the wind is supposed to blow from the same point during the whole voyage, is—that, under this improbable contingency, less advantage is generally conferred by the use of the Great-Circle course in determining the choice of the tack, than if the wind were to vary its direction. For example, if on the 10th day the wind were to shift 25° either to the North or the South: by Great-Circle Sailing, if it veered to the North, the voyage would be shortened seven days two hours; if to the South, two days six hours.* And again, if on the 15th day the wind were again to change from N. 65° W. to S. 65° W., or from S. 65° W. to N. 65° W.: in the one case a saving of five days twenty hours would be effected; in the other, saving of six days four hours.

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* This change of the wind is the most favourable to the employment of the Rhumb course that could be suggested.

TACK NEAREST TO THE RHUMB COURSE.					TACK NEAREST TO THE GREAT-CIRCLE COURSE.				
No. Days out.	Course.	Distance. Miles.	Lat. N.	Long. W.	Course.	Distance. Miles.	Lat. N.	Long. W.	No. Days out.
	°		° ′	° ′	°		° ′	° ′	
- -	- -	- -	49 15	5 5	- -	- -	49 15	5 5	- -
1	S. 25 W.	150	46 59	6 40	N. 25 W.	150	51 31	6 44	1
2	S. 25 W.	„	44 43	8 11	N. 25 W.	„	53 47	8 29	2
3	S. 25 W.	„	42 27	9 39	N. 25 W.	„	56 3	10 19	3
4	S. 25 W.	„	40 11	11 3	N. 25 W.	„	58 19	12 16	4
5	N. 25 W.	„	42 27	12 27	S. 25 W.	„	56 3	14 13	5
6	S. 25 W.	„	40 11	13 51	N. 25 W.	„	58 19	16 10	6
7	N. 25 W.	„	42 27	15 15	S. 25 W.	„	56 3	18 7	7
8	S. 25 W.	„	40 11	16 39	N. 25 W.	„	58 19	20 4	8
9	N. 25 W.	„	42 27	18 3	S. 25 W.	„	56 3	22 1	9
10	S. 25 W.	„	40 11	19 27	S. 25 W.	„	53 47	23 51	10
11	N. 25 W.	„	42 27	20 51	S. 25 W.	„	51 31	25 36	11
12	S. 25 W.	„	40 11	22 15	N. 25 W.	„	53 47	27 21	12
13	N. 25 W.	„	42 27	23 39	S. 25 W.	„	51 31	29 6	13
14	S. 25 W.	„	40 11	25 3	S. 25 W.	„	49 15	30 45	14
15	N. 25 W.	„	42 27	26 27	N. 25 W.	„	51 31	32 24	15
16	S. 25 W.	„	40 11	27 51	S. 25 W.	„	49 15	34 3	16
17	N. 25 W.	„	42 27	29 15	S. 25 W.	„	46 59	35 38	17
18	S. 25 W.	„	40 11	30 39	N. 25 W.	„	49 15	37 13	18
19	N. 25 W.	„	42 27	32 3	S. 25 W.	„	46 59	38 48	19
20	S. 25 W.	„	40 11	33 27	S. 25 W.	„	44 43	40 21	20
21	N. 25 W.	„	42 27	34 51	N. 25 W.	„	46 59	40 52	21
22	S. 25 W.	„	40 11	36 15	S. 25 W.	„	44 43	43 23	22
23	N. 25 W.	„	42 27	37 39	N. 25 W.	„	46 59	44 54	23
24	S. 25 W.	„	40 11	39 3	S. 25 W.	„	44 43	46 25	24
25	N. 25 W.	„	42 27	40 27	S. 25 W.	„	42 27	47 53	25
26	S. 25 W.	„	40 11	41 51	N. 25 W.	„	44 43	49 21	26
27	N. 25 W.	„	42 27	43 15	S. 25 W.	„	42 27	50 49	27
28	S. 25 W.	„	40 11	44 39	N. 25 W.	„	44 43	52 17	28
29	N. 25 W.	„	42 27	46 3	S. 25 W.	„	42 27	53 45	29
30	S. 25 W.	„	40 11	47 27	N. 25 W.	„	44 43	55 13	30
31	N. 25 W.	„	42 27	48 51	S. 25 W.	„	42 27	56 41	31
32	S. 25 W.	„	40 11	50 15	N. 25 W.	„	44 43	58 9	32
33	N. 25 W.	„	42 27	51 39	S. 25 W.	„	42 27	59 37	33
34	S. 25 W.	„	40 11	53 3	S. 25 W.	„	40 11	61 1	34
35	N. 25 W.	„	42 27	54 27	N. 25 W.	„	42 27	62 25	35
36	S. 25 W.	„	40 11	55 51	S. 25 W.	„	40 11	63 49	36
37	N. 25 W.	„	42 27	57 15	N. 25 W.	„	42 27	65 13	37
38	S. 25 W.	„	40 11	58 39	S. 25 W.	„	40 11	66 37	38
39	N. 25 W.	„	42 27	60 3	N. 25 W.	„	42 27	68 1	39
40	S. 25 W.	„	40 11	61 27	S. 25 W.	„	40 11	69 25	40
41	N. 25 W.	„	42 27	62 51	N. 25 W.	„	42 27	70 49	41
42	S. 25 W.	„	40 11	64 15	S. 25 W.	„	40 11	72 13	42
43	N. 25 W.	„	42 27	65 39	N. 25 W.	118	41 56	73 19	42 19 hours
44	S. 25 W.	„	40 11	67 3					
45	N. 25 W.	„	42 27	68 27	S. 25 W.	70	40 41	74 5	43 8 hours
46	S. 25 W.	„	40 11	69 51					
47	N. 25 W.	„	42 27	71 15					
48	S. 25 W.	„	40 11	72 39					
49	N. 25 W.	68	40 41	74 5					
„	S. 25 W.	93							
Total days.									Total 43 days 8 hours.

Composite Great-Circle Sailing.

38. To follow the Great-Circle track rigidly would sometimes lead through latitudes so high as to be impracticable, or at least very unfavourable for navigation; this generally happens, too, when the greatest amount of distance would be saved by following the Great-Circle track; but, though in such cases it would be unwise to follow the Great Circle rigidly, yet there is a very simple application of these Tables which will give the shortest possible route consistent with a restricted maximum Latitude. It is as follows:—

39. Having ascertained, by means of the Linear Index or otherwise, that the Latitude of Vertex is ineligible, you must fix upon a lower latitude as the highest which the ship would be required to attain, and call it the '*Maximum Latitude.*' Consider this Maximum Latitude as the Latitude of Vertex, and turn to the quadrant in the Tables corresponding thereto; then, in proceeding towards the Vertex, find the successive latitudes of the ship's place in the 'Lat.' column, adjacent to which may be found the respective courses.

40. When the ship has reached the Vertex, which will necessarily be as soon as she has attained the '*Maximum Latitude,*' the voyage must be conducted along the parallel, until the difference of longitude of the ship and destination is equal to the Longitude from Vertex as given in the side-column agreeing to the latitude of the destination in the column 'Lat.' in the same quadrant with which we started (39). But, when the Vertex and destination are on different sides of the Equator, the ship must continue to sail upon the parallel until the difference of longitude of the ship and destination is equal to the *supplement* of the Longitude from Vertex mentioned above. In either case, as soon as this equality is attained, the ship has again reached the Vertex of the quadrant which passes through the destination; and, consequently, the courses may be found in the Table corresponding to the ship's Longitude from Vertex (15).

41. The route thus obtained will be the shortest possible under the specified conditions. It consists of adjacent parts of three tangent circles; the middle part being a portion of the parallel fixed upon as the maximum Latitude (39), while the other two are arcs of Great Circles, the first extending from the place of departure to the Vertex, and the last from the Vertex to the place of destination: or it may happen that either the latitude of the ship's place, or that of the port bound to, may be the 'Maximum Latitude,' in which case the route will consist of adjacent parts of two tangent circles,—viz. the arc of a Great Circle and a portion of the parallel of the Maximum Latitude.

42. The distance run in this Composite track may be easily calculated in three parts: the middle, or parallel, by the rules of Parallel Sailing; whilst each of the arcs of the Great Circle will be easily resolved thus:—To the log. sin. of the latitude of the place of departure or destination (as the case may be), add the log. cosec. of the '*Maximum Lat.*' (39); the sum, rejecting 10, will be the log. cos. of the arc between the Vertex and the place of departure or destination. The sum of the three arcs determined by these rules will be the distance run. The numb of degrees to be navigated, upon the parallel of the maximum latitude, will be th difference of longitude of the place of departure and destination, less the sum (the degrees of longitude run upon the Great Circle arc or arcs.

43. Example XV.—Required the distance run by the Composite track between Lat. 43° 11′ S. and Lat. 33° S.; the difference of longitude being 140° 30′, and 50° the highest or maximum latitude to be sailed in?

First Arc.				Third Arc.			
	°	′			°		
Sin.	43	11	= 9·835269	Sin.	33	0	= 9·736109
Cosec.	50	0	= 10·115746				10·115746
Cos.	26	42	= 9·951015	Cos.	44	41	= 9·851855
or 1602 miles.				or 2681 miles.			

Middle Arc.

	°	′
Long. of place of departure from Vertex - - =	38	0
Long. of place of destination from Vertex - =	57	0
Sum—Longitude run upon the Great Circles =	95	0
Given difference of Longitude - - - - - =	140	30
Longitude sailed upon the parallel - - - - =	45	30

∴ Log. 45° 30′ or 2730 mi. = 3·436163
Log. cos. 50° 0′ - - - = 9·808067
Log. 1755 mi. (distance) = 3·244230

	Miles.	
Then	1602	= the first arc.
	1755	= the second or middle arc.
	2681	= the third arc.
Total distance run =	6038	miles.

N.B. The same voyage made by the Rhumb course, N. 84° 44′ E., would be 6662 miles nearly; and, by the single Great Circle, Lat. of Vertex 67° S., the run (if practicable) would be very nearly 5742 miles.

To trace the Composite route on the Chart.

44. Proceed, as previously directed (22), to trace two Great Circle arcs, the Latitude of Vertex of which is the 'Max. Lat.' These arcs must be so drawn as to extend the one from the ship's place to vertex, the other from her destination to vertex. From the vertex of the one arc to that of the other draw a straight line, which will be a tangent to each of these arcs, at vertex, thus connecting them and completing the Composite route.

45. EXAMPLE XVI.—Required the elements for tracing on a chart, which has drawn on it every 5th degree of longitude, the Composite route between Van Diemen Land, Lat. 43° 14′ S., Long. 147° 52′ E., and Valparaiso, Lat. 33° S., Long. 71° 40′ W.; the Max. Lat. being 50°?

Track from Van Diemen Land to Max. Lat.

Long. from Greenwich	148° E.	150° E.	155° E.	160° E.	165° E.
Long. from Vertex	38	36	31	26	21
Latitude	43° 12′	43° 57′	45° 37′	46° 58′	48° 3′
Long. from Greenwich	170° E.	175° E.	180°	175° W.	174° W.
Long. from Vertex	16	11	6	1	0
Latitude	48° 52′	49° 29′	49° 51′	49° 59′	50° 0′

Track from Valparaiso to Max. Lat.

Long. from Greenwich	72° W.	75° W.	80° W.	85° W.	90° W.	95° W.	100° W.
Long. from Vertex	57	54	49	44	39	34	29
Latitude	32° 58′	35° 2′	38° 1′	40° 36′	42° 48′	44° 39	46° 11′
Long. from Greenwich	105° W.	110° W.	115° W.	120° W.	125° W.	129° W.	
Long. from Vertex	24	19	14	9	4	0	
Latitude	47° 26′	48° 24′	49° 10′	49° 39′	49° 56′	50° 0′	

Between Longitude 174° W. and 129° W. the ship must sail on the parallel of 50° S.; consequently, this part of the track must be represented on the Chart by a straight line.

APPLICATION OF THE LINEAR INDEX AND GREAT-CIRCLE TABLES TO THE DETERMINATION OF AZIMUTHS.

No one who has even casually perused Capt. Johnson's "Practical Illustrations of the necessity for ascertaining the Deviation of the Compass" can regard the subject otherwise than as one of the greatest importance. The present extensive employment of Steam-vessels, and the increased use of Iron in the construction of every class of vessel, require that more than ordinary attention should be directed to every means for ascertaining the amount of deviation which (under every variety of circumstance) may arise from these causes. It is shown that the compass is subject to ever-changing influences, varying with the direction of the head and the heeling of the ship, and that even the deviations produced are not constant quantities, but change with every latitude, being generally westerly in the southern hemisphere on the points on which they are easterly in the northern, and easterly in the former where they are westerly in the latter. From the recent observations of Sir James C. Ross it appears that a certain time is necessary for the inductive influence of the earth's magnetism to produce its full effect on the polarity of the ship's iron, and, consequently, in the same ship, in the same latitude, with the ship's head directed to the same point, and at the same degree of inclination, the compass will, at different times, exhibit various degrees of deviation. These circumstances increase the necessity of constant observation in every ship, and it is therefore presumed that every method which tends to abridge the labour of taking or calculating Azimuths is well worthy of attention.

The Tables for facilitating Great-Circle Sailing will, by a very slight modification of the Rules, afford a most convenient and expeditious method of ascertaining (by inspection) the Azimuth of any heavenly body, without an altitude, the hour-angle being known.

The Azimuth of a heavenly body may be considered as the Great-Circle Course to the place where such heavenly body is vertical at the moment. It is, therefore, only necessary to substitute the hour-angle of the heavenly body for the difference of longitude, and its declination for the latitude of destination, and the 'Course' given in the tables will be the Azimuth required, or the Azimuth may be found by the following rules:—

To find the Azimuth of a Heavenly Body.

1. Find the Latitude of Vertex and the Longitude from Vertex, by means of the Linear Index, as follows:—

Take out, with a pair of compasses, the hour-angle from the scale of Intervals of Time for Azimuths, in the 'Linear Index,' in the same manner as divisions and proportional parts are taken out from the ordinary diagonal scale of equal parts; for an example of this process see article 10, page 39, in the Explanation to the Tables.

Next, when both the ship's place and the declination have the same name (N. or S.) set the right point of the compasses on the curve of the ship's latitude or on that of the declination (whichever is the lesser quantity) in the division nearest to the right hand;* follow this curve up or down, till the left point meets the curve answering either to the ship's latitude or the declination (whichever is furthest from the Equator); and the degree of latitude represented by the index-line nearest to the points of the compasses must be taken as the Latitude of the Vertex required. In thus taking out the Latitude of Vertex we must observe whether the vertical line called 'Meridian of Vertex' does or does not come between the points of the compasses, to enable us to determine from which Pole the Azimuth must be reckoned.

If the latitude and declination have unlike names (one N. and the other S.), set the left point of the compasses on the curve of the declination in the diagram nearest to the left hand; move the point along this curve,* till the right point meets the curve of the ship's latitude on the other side of the 'Equator' line, and the degree indicated by the nearest index-line will be the Latitude of Vertex.

The Latitude of Vertex being thus found, let one point of the compasses remain upon the curve of the ship's latitude, and bring the other point to the vertical line 'Meridian of Vertex,'* opening or closing the compasses as may be necessary; the distance thus taken by the compasses, being applied to the scale of difference of longitude, will show the Longitude from Vertex.

II. The Latitude of Vertex and Longitude from Vertex being found as above directed, to take out the Azimuth:—

Open the Tables at the part corresponding to the Latitude of Vertex, and in the column 'Course,' agreeing with the Longitude from Vertex in the side column, will be found the Azimuth required.

The Azimuth will be S. if the latitude be N., or N. if the latitude be S., except when the polar distance is less than the co-latitude, or when the line called 'Meridian of Vertex' comes between the points of the compasses in determining the Latitude of Vertex; for, in either of these cases, the Azimuth will be N. or S., according as the latitude is N. or S. In all cases the Azimuth of the Sun must be E. if apparent time be A.M., and W. if P.M.; and in the case of any other heavenly body it is E. or W., according as the time of observation is before or after the time of its passing the meridian.

EXAMPLES.

I. When the polar distance is less than the co-latitude.

Example.—Ship's lat. 13° 45′ N., Sun's dec. 20° N., apparent time 2h. 5m. P.M.: to find the Sun's true Azimuth.

Take in the compasses $2^h\ 5^m$ from the scale of Intervals of Time, and apply the distance upon the curvilinear index, as directed above, when the Latitude of Vertex will be found to be 21°. Let one point of the compasses remain upon the curve 14°,† to which it has just been applied, and bring the other point to the vertical line 'Meridian of Vertex,' as above directed; this distance applied to the diagonal scale of Difference of Longitude will give 51° nearly as the Longitude from Vertex.

---

* In applying the compasses to the Linear Index the points must (in all cases) be kept parallel to the Index Lines.

† The nearest whole degree to the arc, either of latitude or declination, will give the result sufficiently approximate.

Next, turn to the table 'Lat. of Vertex' 21°, and, corresponding to 'Long. from Vertex' 51°, we shall have under 'Course' 73° 51′; this is the Azimuth. It is N. because the polar distance is less than the co-latitude, and W. because the time is P.M.

II. Polar distance greater than co-latitude, and the 'Meridian of Vertex' not between the points of the compasses.

Example.—Ship's lat. 20° N., Sun's dec. 13° 45′ N., apparent time 9h 55m. A.M.: to find the Sun's true Azimuth.

This being a case of apparent time A.M., we take apparent time from 12h. to obtain the hour-angle which (as before) is $2^h\ 5^m$. The Latitude of Vertex is therefore the same (21°, 'both out'), but the Longitude from Vertex in this example is the distance of the curve 20° from the 'Meridian of Vertex,' equal to about 19°, giving the Azimuth S. 83° 17′ E. This Azimuth is S. because it is not one of the exceptions, and E. because it is A.M.

III. 'Meridian of Vertex' between the points of the compasses.

Example.—Ship's place 20° N., Sun's dec. 13° 45′ N., apparent time 7h. 28m. A.M.: to find the Sun's true Azimuth.

This example differs only from the preceding one on account of the greater hour-angle (4h. 32m.) causing the Meridian of Vertex to come between the points of the compasses in determining the Latitude of Vertex; the Azimuth is, therefore, N. 83° 17′ E.

IV. 'Equator' between the points of the compasses.

Example.—Ship's place 20° N., Sun's dec. 13° 45′ S., apparent time 7h. 28m. A.M.: to find the Sun's true Azimuth.

In this case the curve 14° * agreeing with the Sun's declination must be thta in the left-hand division, and the curve 20°, representing the latitude, must be on the right hand side of the 'Equator' line, because the declination and latitude are of different names. The Latitude of Vertex is 29° nearly, the longitude from Vertex 49°, and the Azimuth given by the Tables is S. 68° 32′ E.

In the last example the Latitude of Vertex is between 28° and 29°; the exact Azimuth is 68° 53′. If we take 28° as the Latitude of Vertex (instead of 29° as above) the Tables will give 69° 15′ as the Azimuth. But either is sufficiently approximate for any practical purpose.

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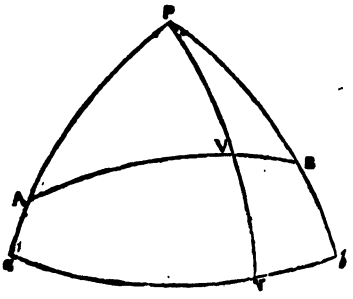
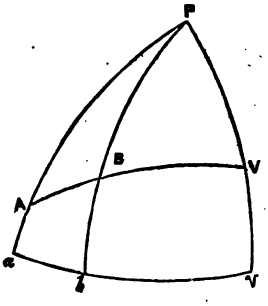
* The nearest whole degree to the arc, either of latitude or declination, will give the result sufficiently approximate.

CONSTRUCTION OF THE LINEAR INDEX AND OF THE TABLES.





To explain the construction of the curvilinear part of the Linear Index let **A** and B represent two points on the surface of the globe; one being a place of departure, the other a place of destination. Let a Great Circle pass through these points; and, if P represent the pole of the earth, the two meridians P A and P B being drawn will complete the spherical triangle P A B. The points *a*, *v*, *b* are on the equator. From P, the pole, draw P V perpendicular to the base of the triangle A B: this perpendicular is a part of the Meridian of Vertex (2, p. 38) of the Great Circle passing through A and B. First, let the perpendicular fall within the triangle, then P V divides it into two right-angled spherical triangles, viz. A P V and B P V.

In the spherical triangle A P V,

$$\cos \text{A P V} = \frac{\tan \text{V P}}{\tan \text{A P}}$$

or, substituting for V P and A P their complements V *v* and A *a*, we have

$$\cos \text{A P V} = \frac{\tan \text{A } a}{\tan \text{V } v}. \quad . \quad . \quad . \quad (1)$$

This angle is what is called in the precepts the Longitude from Vertex of the station A.

And, in the triangle B P V, we have similarly—

$$\cos \text{B P V} = \frac{\tan \text{B } b}{\tan \text{V } v}. \quad . \quad . \quad . \quad (2)$$

Now these formulæ remain the same, whether the perpendicular falls within or without the triangle, and for all possible values of the parts named.

In either equation, any two of the terms being given, the third becomes known: and, from the similarity of the expressions in (1) and (2), it is obvious that each of these equations, calculated for all possible values of V v and A a or B b, will give the same series of results for the arc A P V or B P V, and embraces all the values that the arc can have.

The successive values of the arc a v have been calculated for all the integral values of V v and A a from 1° to 89° inclusive, and the results tabulated and projected as ordinates to the axis, named in the Linear Index the Meridian of Vertex; and the lines connecting the extremities of these ordinates form the curves in the Index.

The horizontal or Index lines have been drawn at equal intervals, and the curves have been laid off by points, in a manner which perhaps will be best understood by an example, as follows:—

Let the Index Line be 35°, and the lat. of A be 17°; then, substituting these for V v and A a respectively in Eq. (1), we have—

$$\cos \text{A P V} = \frac{\tan 17^\circ}{\tan 35^\circ} = \cos 64^\circ\ 7'$$

Again, substituting 33° for A a—

$$\cos \text{A P V} = \frac{\tan 33^\circ}{\tan 35^\circ} = \cos 21^\circ\ 58'$$

Upon the Index Line 35°, set off to the right and left from the axis the two arcs here calculated, taken from the diagonal scale. The first two of these give the points of intersection of the Index Line with the curve of Lat. 17°, one on each side of the Meridian of Vertex; the last two the similar points of intersection for the curve of lat. 33°. In the same way have the other points of intersection for the curves for each degree of latitude less than the Latitude of the Vertex been found: and, repeating the process for each Index Line or degree of Latitude of Vertex, the whole of the points of intersection have been determined.

It only remains now to be shown how these projected results can be made available in abridging future labour. For example: Let A be a place of departure in lat. 17°, and B a place of destination in lat. 33°, and let the difference of longitude of these places be 86° 5′. Then, since the arcs or ordinates corresponding to this difference of longitude have been projected upon one or other of the Index Lines; and since through the extremity of one ordinate passes the curve of Lat. 17°, and through the other the curve 33°; if we open the compasses to the ance 86° 5′, and try it upon the diverging curves 17° and 33° at each of the ex Lines, we shall find that particular one upon which the distance of the ves apart and the opening of the compasses are equal: such Index Line will essarily have the same number as the degree of the Latitude of Vertex, for n this Index Line the difference of longitude must have been set off.

In the above example, Latitude of Vertex is 35° ; and the intersections of this corresponding Index Line with the curves 17° and 33°, which agree to the required distance of 86° 5′ apart, are found to be upon opposite sides of the axis: *viz.*, the curve of 17° is at the distance of 64° 7′ from the axis on one side, and the curve of 33° at 21° 58′ from the axis on the other side ;

$$\text{giving } 64° 7' + 21° 58' = 86° 5'.$$

If the difference of Longitude had been 42° 9′, we should have found the corresponding distance apart of the curves on the same Index Line as before, but both on the same side of the axis, the ordinates being of the same magnitude as in the preceding case ; or

$$64° 7' - 21° 58' = 42° 9'.$$

On inspecting the figures, we perceive that, generally, $A\,P\,B = A\,P\,V \pm B\,P\,V$, according as the perpendicular is within or without the triangle A P B.

It is unnecessary *a priori* to know whether the perpendicular be within or without the triangle, as the application of the difference of longitude in the compasses to the proper curves will always immediately decide the matter. The required distance apart of the given curves can only be found at one place, and that is upon the line of the Lat. of Vertex, as shown in the preceding Articles.

From what has been said above, the reasons for the directions given in Article (11) will be apparent ; and with reference to the additional directions in (12), we may explain, that an exact copy of the right-hand compartment of the Linear Index is given in the left-hand compartment, as will be observed on examining it. This is done to meet cases in which the places of departure and destination are on opposite sides of the Equator ; and hence the name of the vertical line called Equator in the diagram. As these cases involve only a slight extension of the application of the formulæ given above, we shall leave them without further comment.

It is only necessary further, for the purposes of Great-Circle Sailing, that the accompanying Tables should furnish the latitude of the ship's place as it progresses along the Great Circle from A to B ; also the course or varying angle P A V throughout the same changes of latitude, and the parts of the base A V corresponding to the same variations. The tables contain these elements calculated for each degree of longitude throughout one quadrant of each of 89 Great Circles, thereby furnishing the elements of a Great Circle for each degree of inclination to the Equator from 1° to 89° inclusive.

And, again referring to the Figures, we remark the following trigonometrical relations :—

$$\frac{\cos A\,P\,V}{\tan P\,V} = \cot A\,P \text{ (co-latitude)} \quad . \quad . \quad . \quad . \quad (3)$$

$$\sin A\,P\,V \cos P\,V = \cos V\,A\,P \text{ (course)} \quad . \quad . \quad . \quad (4)$$

$$\text{and } \frac{\sin P\,V}{\cot A\,P\,V} = \tan A\,V \text{ (distance)} \quad . \quad . \quad . \quad . \quad (5)$$

Or, in these formulæ, substituting for the perpendicular P V its complement V v (the latitude of Vertex), and for A P substituting A a (the latitude of A), we have

$$\cos A\,P\,V \tan V\,v = \tan A\,a \text{ (lat.)} \quad . \quad . \quad (6)$$
$$\sin A\,P\,V \sin V\,v = \cos V\,A\,P \text{ (course)} \quad . \quad . \quad (7)$$
$$\tan A\,P\,V \cos V\,v = \tan A\,V \text{ (distance)} \quad . \quad (8)$$

In calculation, the last three formulæ are preferable to those preceding; because in (6) (7) and (8) the latitudes are used, but in (3) (4) and (5) the co-latitudes. It may be observed further, that the formulæ given with reference to the triangle P A V will equally apply to the triangle P B V.

NOTE.

SHOULD the Linear Index be lost or rendered unserviceable, the Tables may still be useful by adopting the following methods.

Let A and B represent the ship's place and her destination; A being whichever is the nearer to the Equator; let a and b represent the longitudes from Vertex, as given in one of the Tables corresponding to the latitudes of A and B respectively; also let c represent the difference of longitudes of the stations A and B, and $\pi - c$ the supplement of c.

To find the situation of the Meridian of Vertex with reference to A and B.—Turn to the Table whose 'Lat. of Vertex' is equal to the latitude of B; then, under 'Lat.,' find the nearest latitude to that of A; and the corresponding number in the side column 'Long. from Vertex' is a.

Then when A and B are of the same name (both N. or both S.); if $a > c$ it is a case of 'both out;' if $a < c$ it is a case of 'Mer. in.'

But, when A and B are of different names (one N. and the other S.); if $a < \pi - c$, it is a case of 'Equator in;' if $a > \pi - c$, it is a case of 'Mer. and Equator in,' or 'Equator and Mer. in,' according as the ship or her destination is further from the Equator.

To determine the Lat. of Vertex.—If in determining the case it appears that a is equal to c, then the latitude of B is the Lat. of Vertex; but if this equality does not obtain, ascertain by inspection which of the succeeding Tables will satisfy the under-mentioned equation which corresponds to the particular case, and the latitude of Vertex of this Table is the Lat. of Vertex required. The equations are as follows:—

in cases of 'both out' $a - b = c$; in cases 'Mer. in' $a + b = c$

'Equator in' $a + b = \pi - c$; Mer. and Equator in, or Equator and Mer. in $a - b = \pi - c$

If from two consecutive Tables the values of a and b are such as to make from the one the equation in excess and from the other in defect, the exact 'Lat. of Vertex' will lie between them, and may be found by the method of proportional parts.

The Long. from Vertex of A is a, as given by the Table, but the Long. from Vertex of B will be—

$= a - c$, when 'both out'
$c - a$, . . . 'Mer. in'
$(\pi - c) - a$, . . . 'Equator in'
$a - (\pi - c)$ . . . 'Mer. and Equator in,' or 'Equator and Mer. in.'

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